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SECOND SERIES: PULMONATA.

MANUAL

OF

CONCHOLOGY

STRUCTURAL AND SYSTEMATIC

WITH ILLUSTRATIONS OF THE SPECIES

FOUNDED BY

GEORGE W. TRYON, JR.

CONTINUED BY

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Part 93. Colored.

PHILADELPHIA:

PUBLISHED BY THE CONCHOLOGICAL DEPARTMENT

ACADEMY OF NATURAL SCIENCES

OF PHILADELPHIA.

SECOND SERIES: PULMONATA

MANUAL

OF

CONCHOLOGY

VOL. XXIV

PUPILLIDÆ (GASTROCOPTINÆ)

BY

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PHILADELPHIA:
PUBLISHED BY THE CONCHOLOGICAL DEPARTMENT
ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA
1916–1918

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CONTENTS

PAGE

Introduction—
- Terminology of the teeth of Pupillidæ vii
- The family Pupillidæ x
- The subfamily Gastrocoptinæ x

Descriptions of genera and species—
- The Gastrocopta group of genera.
  - Genus Chænaxis Pilsbry & Ferriss (Arizona). 1
  - Genus Gibbulina Beck (South America)..... 5
  - Genus Gastrocopta Wollaston 6
    - North American and West Indian species.. 12
    - South American species 89, 357
    - Species of Eastern Asia, Japan and Indo-China 103
    - Species of Western Siberia and the European Tertiary 112
    - Species of Africa and the Mascarene Islands 118, 358
    - Species of Ceylon, India and Malay Peninsula 134
    - Species of the Philippines, Polynesia and Melanesia 140
    - Australian species 155
  - Genus Bothriopupa Pilsbry (Tropical America) 226
- The Hypselostoma-Boysidia group of genera 172
  - Genus Hypselostoma Benson (Oriental Region) 175, 360
  - Genus Anauchen Pilsbry (Oriental Region).. 188
  - Genus Boysidia Ancey (Oriental Region) 192
  - Genus Gyliauchen Pilsbry (Oriental Region). 210
- The Aulacospira-Systenostoma group of genera 220
  - Genus Aulacospira Moellendorff (Philippines). 220

PAGE

Genus SYSTENOSTOMA Bavay & Dautzenberg (Oriental Region) 224
The Abida group of genera 232
Genus FAUXULUS Schaufuss (South Africa)... 234
Genus ODONTOCYCLAS Schlueter (Europe) 254
Genus SANDAHLIA Westerlund (Europe) 258
Genus ABIDA Leach (Europe) 262
Genus GRANOPUPA Boettger (Palæarctic Region) 332
Appendix 357
Explanation of Plates 361
Dates of publication, parts 93-96 371
Index 373

PREFACE

Illustrated monographs of "Pupa" have been published by Küster, 1849, and by Sowerby, 1872. In his *Monographia Heliceorum*, 1848-1877, Pfeiffer included descriptions of the species then known. The last general work is therefore forty years old. Meantime the number of genera and species has greatly increased, and taxonomic ideas have changed so radically that the classification and nomenclature of this volume bear little resemblance to those of former works.

Owing to the minute size of many of these shells, the proportion of inadequate or erroneous descriptions and of useless or misleading figures in the existing literature is very large.

The Gastrocoptinæ, described in the present volume, is the largest of the half-dozen subfamilies of Pupillidæ to be considered in this monograph. It is also the most widely distributed; so that species from practically all countries are included here.

The literature of Pupillidæ is extensive, since most faunal papers on land snails contain some species. In treating of European and North American forms, therefore, a selection has been made of the references thought most important. To include references and localities from all local lists, especially in Europe, would unduly increase the size of the work; and while the importance of the material is appreciated, its collation may properly be left for faunal works, in which the accuracy of the references can be controlled, and the details of distribution worked out, by investigators having the requisite local knowledge. Outside of the European and North American faunas, the author has aimed to give all references of any value, and all localities which have been published, omitting only mere lists and compilations containing no new information or localities.

While every care has been taken to omit nothing essential, it cannot be expected that everything of importance has been noted. The author will be grateful for information relating to omissions or errors in this volume. Also for information or

specimens bearing on the work to follow, upon the *Pupillinæ*, *Orculinæ*, *Vertigininæ* and other groups.

Specimens and information used in this volume have been given generously by many zoologists. Part of these favors have been acknowledged in the text, but special thanks are due to—

Dr. N. Annandale, Superintendent of the Indian Museum, for a series of Indian Pupillidæ.

Dr. Paul Bartsch, Curator of Marine Invertebrates, for Antillean and South American species from the National Museum.

Mr. H. C. Burnup, for valuable notes on South African species, with numerous specimens.

Dr. Geo. H. Clapp, for forms collected by him in the Bahamas, Florida and elsewhere.

Dr. Wm. H. Dall, for the loan of Galapagos Pupæ.

Mr. John Farquhar, for South African Pupillidæ collected by him.

Mr. Charles Hedley, of the Australian Museum, for many specimens of Australian Pupæ, and information on several species.

Mr. John B. Henderson, for the use of his large series of Antillean Pupillidæ.

Dr. V. Sterki, for various American species.

Mr. B. B. Woodward, who kindly reported on several types in the British Museum and gave other useful notes on the group.

Mention should also be made of the gifts, continued through many years, of my constant friends Mr. Jas. H. Ferriss and Mr. Y. Hirase, which have added largely to the material at hand.

The firm of Sowerby & Fulton has taken pains to procure for me a number of rare species, not accessible elsewhere.

That the Manual is able to continue during these unhappy days, when a considerable part of its support from abroad is cut off, and the difficulties of publication are increased, is due to the interest of the Council and Publication Committee of the Academy, who have steadfastly encouraged the work.

H. A. P.

INTRODUCTION

Terminology of the Teeth of Pupillidæ.

Though a definite terminology of the teeth of Pupæ has been in use for about seventy years by such scholarly authorities as Pfeiffer, Rossmaessler, Benson and others, many species have been described as though no terminology existed, or using other terms than those of Pfeiffer. This often leaves us in uncertainty as to the meaning, and produces great diversity among the original descriptions quoted or translated in this monograph. It has not been practicable to reduce the descriptions to a common terminology, since although one can usually tell what teeth are described, yet in too many cases there is uncertainty. Authors have often described the position of each tooth elaborately—a waste of ink, since the positions are practically invariable except in the degree of immersion. The use of the terms labrum and labium (labral and labial) has also led to confusion in many cases; as these terms are superfluous they may be abandoned with advantage.

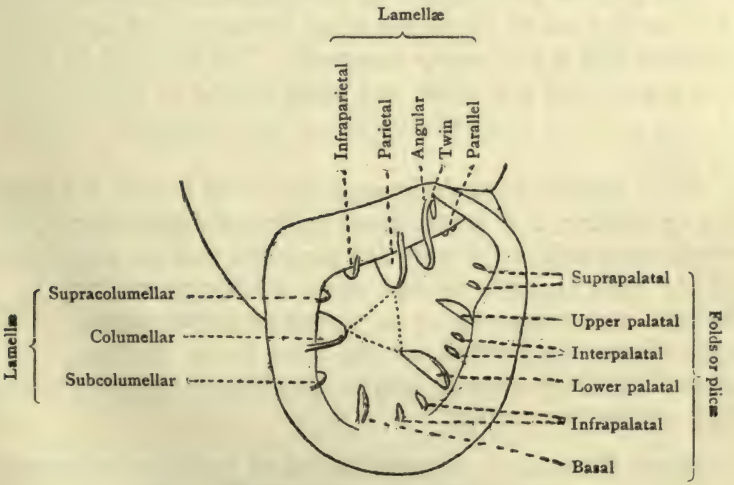


FIG. 1. Terminology of lamellæ and folds.

The principal folds or teeth have definite positions and are homologous throughout the group. The terminology now in use is an amplification of that of Pfeiffer, 1848 (*Monographia Heliceorum*, ii, p. 300).

All teeth or laminæ upon the parietal and columellar margins are called *lamellæ*, whatever their shape; all within the outer lip are called *folds* or *plicæ*. In the following table the names of the secondary, usually variable teeth, are italicized.

Upon the parietal wall	*Twin lamella, parallel lamellae.*	Lamella angularis and L. parietales. Plis supérieurs
	Angular lamella, *spiral lamella.*	
	Parietal lamella.	
	Infraparietal lamella.	
Upon the columella	*Supracolumellar lamella.*	Lamellae columellares. Spindelfalten
	Columellar lamella.	
	Subcolumellar lamella.	
Within the outer and basal margins	*Sutural* and *Suprapalatal folds.*	Plicae palatales and Plica basalis. Gaumenfalten.
	Upper palatal fold.	
	Interpalatal folds.	
	Lower palatal fold.	
	Infrapalatal folds.	
	Basal fold.	

A suprapalatal fold, when situated close below the suture, is often called a *sutural fold.*

The parietal and columellar lamellæ and the lower palatal fold usually are at the angles of an equilateral triangle, when the said fold is not deeply immersed. This is useful in fixing the identity of the plicæ, not always clear in multidentate forms, or those in which there has been extensive reduction of teeth.

Some authors have designated the folds within the outer lip by number, 1, 2, 3, etc., from the upper downwards. This serves very well for descriptive purposes, but the homologies of the folds are entirely lost, since the upper one may be a sutural, a suprapalatal or an upper or lower palatal. This also affects the identity of the folds below the first. The second fold in one species may be homologous with that called first or third in another.

Tooth Formulas.—Several modes of briefly stating tooth

arrangements have been proposed. The simplest gives merely the number of teeth on each margin; thus 2–1–3 denotes two teeth on the parietal wall, one on the columellar and three in the outer and basal margins. If more definite information is to be conveyed, the initials of the teeth may be used, those representing concrescent or united teeth being enclosed in parentheses, as follows:

a. Angular lamella.
p. Parietal lamella.
ip. Infraparietal lamella.
c. Columellar lamella.
sc. Subcolumellar lamella.
s. Suprapalatal fold.
u. Upper palatal fold.
i. Interpalatal fold.
l. Lower palatal fold.
b. Basal fold.

Thus, (a.p.)–c–u.l.b. denotes the presence of united angular and parietal lamellæ, a columellar lamella, upper and lower palatal and basal plicæ. While more cumbersome than the numerical formula, this has the advantage of showing what teeth are present, information more important than the mere number. The practical utility of such formulas is open to question. Space is saved, but at the expense of those who use the work.

Family PUPILLIDÆ Turton.

Pupilladæ Turton, Manual of the Land and Fresh-water Shells of the British Islands, 1831, p. 97.

Pupidæ of most authors.

A synopsis of the general classification of *Pupillidæ* with keys to genera will be deferred until the last volume treating of the family, when the details shall have been worked out. A provisional list of the subfamilies here given may serve for reference temporarily. A few of the leading genera are mentioned as examples.

Gastrocoptinæ: *Gastrocopta, Hypselostoma, Abida.*
Pupillinæ: *Pupilla, Pupoides.*
Pagodininæ: *Pagodina, Aspasita.*
Acanthinulinæ: *Acanthinula.*
Vertigininæ: *Vertigo, Nesopupa, Trancatellina.*
Orculinæ: *Orcula, Lauria.*
Strobilopsinæ: *Strobilops.*

The family has been given rather wide limits, and it may be that part or all of the subfamilies will eventually be elevated to families; yet our knowledge of the soft anatomy of the group is merely fragmentary, and it seems best in a systematic work not to go too far ahead of the evidence. At present it is more important to demonstrate the affinities existing between the genera and other groups.

At least four of the subfamilies contain Helicoid forms. In three of them they are associated with lengthened or cylindric genera, but the *Strobilopsinæ* contains only conic and Helicoid species. Except *Hypselostoma*, these Helicoid genera have usually been placed with the Helicidæ.

Subfamily Gastrocoptinæ Pilsbry.

Pupillidæ with the lower tentacles developed, though generally short, the shell without lamellæ or plicæ in the neanic stage; typically having angular, parietal and columellar lamellæ and two or more palatal plicæ.

This subfamily is related to the *Pupillinæ* (*q. v.*), but distinguished by the different arrangement of apertural teeth of typical forms in all the genera. As most genera have also series which are catamorphic or degenerative in teeth, differential diagnosis of these subfamilies are not now practicable. Nevertheless, a study of the more fully toothed forms of each genus shows that the subfamily is a natural group.

The genera of *Gastrocoptinæ* fall into four collateral series, as follows:

I. Small (length 4 mm. or less, 4 to 6½ whorls), thin, corneous or brown.

THE GASTROCOPTA GROUP. Pupiform; angular and parietal lamellæ converging or united.

Gibbulina, p. 5. South America.
Chænaxis, p. 1. North America.
Gastrocopta, p. 6. Nearly world-wide.
Bothriopupa, p. 226. Tropical America.

THE HYPSELOSTOMA-BOYSIDIA GROUP. Pupiform, conic or depressed, last whorl tangential (p. 172).

Hypselostoma, p. 175. Oriental.
Boysidia, p. 192. Oriental.
Gyliauchen, p. 210. Oriental.

THE AULACOSPIRA GROUP. Helicoid, the last whorl not tangential (p. 220).

Aulacospira, p. 220. Philippines.
Systenostoma, p. 224. Indo-China.

II. Mainly larger, more solid shells of cylindric, conic or turrited form, usually with more whorls, which are more closely coiled than in the preceding groups.

THE ABIDA GROUP (p. 232).

Fauxulus, p. 234. South Africa.
Odontocyclas, p. 254. Eastern Alpic region.
Sandahlia, p. 258. Pyrenees.
Abida, p. 262. Europe.
Granopupa, p. 332. Mediterranean countries.
Chondrina (Vol. XXV). Europe, Morocco.

Distribution.

The discussion of distribution is deferred until the conclusion of the monograph. The genera of Gastrocoptinæ range as follows:

Palaearctic Region: *Gastrocopta, Odontocyclas, Sandahlia, Abida, Granopupa, Chondrina.*

Ethiopic Region: *Gastrocopta, Fauxulus.*

Oriental Region: *Gastrocopta, Hypselostoma, Boysidia, Gyliauchen, Aulacospira* and *Systenostoma.*

Australian Region: *Gastrocopta.*

Nearctic Region: *Gastrocopta, Chaenaxis.*

Neotropic Region: *Gastrocopta, Bothriopupa, Gibbulina.*

Gastrocopta is thus the only genus found on all the continents. All the others are confined to single faunal Regions.

MANUAL OF CONCHOLOGY.

DESCRIPTIONS OF GENERA AND SPECIES.

Genus CHÆNAXIS Pilsbry & Ferriss.

Chænaxis PILS. & FERR., Proc. A. N. S. Phila., 1906, p. 145.

The shell is cylindric or slightly tapering, having a *large, hollow axis, open below*, and about one-third the total diameter of the shell; lamellæ and plicæ substantially as in the typical group of *Gastrocopta*, the angular and parietal lamellæ being wholly concrescent into one lobed lamella; columellar lamella well-developed, horizontal; a deeply entering supra-columellar lamella is sometimes developed. Upper and lower palatal plicæ and basal plica present.

Type *C. tuba* (P. & F.). The known species live in Arizona.

A broadly open umbilicus at all stages of growth is unusual in *Pupillidæ*. Its development in *Chænaxis* seems sufficient ground for generic rank, even though the rest of the organization is essentially that of *Gastrocopta*, at least so far as the shell is concerned. The position of the basal plica, as well as the structure of the wholly concrescent angulo-parietal lamella, show that *Chænaxis* was derived from the southern typical *Gastrocopta* stock, not from the northern *Albinula* and *Sinalbinula* group of the genus.

Key to Species.

a. Last whorl having a long cord-like spiral lamella on the axis.

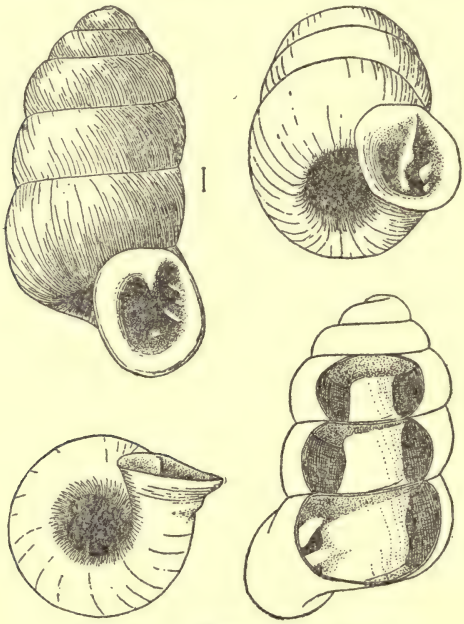
b. Internal lamella 1½ to 2 whorls long.
C. intuscostata, no. 2.

*b*¹. Internal lamella about 1 whorl long.
C. i. brevicostata, no. 2*a*.

*a*¹. Last whorl without a long spiral lamella inside.
C. tuba, no. 1.

1. CHÆNAXIS TUBA (Pilsbry & Ferriss). Pl. 9, figs. 1, 2, 3.

The shell is cylindric with a short terminal cone, *openly umbilicate*, the umbilicus nearly one-third the diameter of the shell, its large cavity penetrating to the first whorl. Pale brown, smooth, marked with light growth-lines. The apex is obtuse. Whorls 5½, convex, the last three forming the cylindrical part of the shell; last whorl is compressed laterally and obtusely angular around the umbilicus, scarcely straightened in front; in basal view it expands broadly at the aperture. The aperture is shortly oval, the peristome thin, con-



Figs. 1–4. *Chœnaxis tuba*, type.

tinuous and broadly expanding. The angular and parietal lamellæ are concrescent into one long bilobed lamella. The columellar lamella is rather massive, having a sloping callous or a lower rounded tooth on its lower side; becoming a low cord, it continues inward to the back of the last whorl (pl. 9, fig. 3). The upper and lower palatal and basal folds are

situated as usual, the lower palatal a little more deeply placed and longer than the others, and there is often a small interpalatal denticle. There is no supracolumellar lamella.

Length 3.3, diam. 1.6 mm. (original figure, and pl. 9, fig. 1).

Length 3, diam. 1.5 mm. (smallest in type lot).

Arizona: Drift debris of the San Pedro River, one mile east of Benson (type locality; Ferriss and Pilsbry); near Dos Cabezas Cave, west of the Dos Cabezas Range, Cochise Co. (Mort Wien); Tumamoc Hill, under stones, and in flood debris at the west end of Congress St., Tucson (Pilsbry and Ferriss).

Bifidaria tuba P. & F., Proc. A. N. S. Phila., 1906, p. 145; fig. 6; 1910, p. 144; 1915, p. 390.

This species lives in the arid foothills and low mountains of the Lower Sonoran zone, not in the higher mountains. It is rare in the debris of the San Pedro River, probably washed in from the foothills of the Whetstone Mountains, or possibly the hill country about Tombstone.

A few specimens were found under stones on Tumamoc Hill, and more, together with *C. intuscostata*, in flood debris at the foot of the hills at the west end of Congress St., Tucson. These specimens have a small supracolumellar nodule, sometimes two (pl. 9, fig. 3), but no spiral lamella running inward from it, though there is a shallow spiral depression, scarcely to be called a furrow, on the internal axis.

2. CHÆNAXIS INTUSCOSTATA (Clapp). Pl. 9, figs. 6 to 9.

The shell is openly umbilicate, cylindric, usually longer than *C. tuba*, and composed of about 6½ whorls; light brown. Last whorl, aperture and teeth as in *C. tuba*, but the supracolumellar lamella is almost invariably present and visible from in front, and the subcolumellar nodule is conspicuous. Inside there is a strong, cord-like lamella about 1½ to 2 whorls long, terminating near and behind the supracolumellar nodule.

Length 3.85, diam. 1.65 mm.; 6½ whorls (fig. 9).

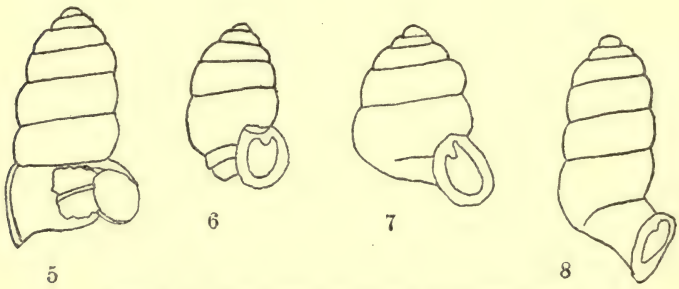
"Length 4.2, diam. 2 mm.; 6¾ whorls (largest)."

"Length 3.25, diam. 1.8 mm.; 5½ whorls (smallest normal shell)."

Arizona: foothills of the Plumosa Range, about 8 miles east of Quartzsite, Yuma Co. (Geo. S. Hutson); debris of Salt River, Tempe, Maricopa Co.; flood debris at west end of Congress St., Tucson (Pilsbry and Ferriss).

Bifidaria tuba subsp. *intuscostata* CLAPP, Nautilus, xxii, Dec. 1908, pp. 76, 96, pl. 7, figs. 1-11.

The main distinctive character of this species is the long, spirally ascending supracolumellar lamella, which is wanting in *C. tuba*. It is also, in the main, longer and more cylindrical than *tuba*. At Tucson it occurs with the latter in storm debris apparently washed out of the Tumamoc Hills. Dr. Clapp has figured several curious abnormal shells found in the original lot.



Figs. 5–8. Abnormal specimens of *C. intuscostata*.

The specimens from Tucson and Tempe are typical in structure. It is rare at Tempe, where the largest taken measures, length 4, diam. 1.7 mm.

2*a*. Form *brevicostata*, new form. Pl. 9, figs. 4, 5. The shell is smaller and tapers more upwards than *B. intuscostata*, and the spiral supracolumellar lamella is only about one whorl long. Length 3.25, diam. above aperture 1.6 mm.

Tempe, Arizona, in drift of Salt River (Pilsbry and Ferriss, Ashmun).

A fragmentary specimen of this was figured in Proc. A. N. S. Phila., 1906, p. 146, fig. 7.

2*b*. Specimens from the Eagle Tail Mountains, 12 miles north of Kofa, Yuma Co., in moist places among piles of loose rock covered by decayed cactus, elevation about 2000 ft. (G. S. Hutson), and also one of those opened from Tucson, have the internal lamella only about a whorl long or less, but they have the cylindric shape and well-developed supracolumellar nodule of *intuscostata*. It is an intermediate form between *intuscostata* and *brevicostata*, but whether racially distinct I am not prepared to say.

Genus GIBBULINA Beck.

Gibbulina Beck, Index Molluscorum, 1837, p. 81.—Gray, P. Z. S., 1847, p. 176 (*P. infundibuliformis* selected as type).

Infundibularia Pfeiffer, Malak. Blätter, xxiii, 1876, p. 213 (monotype *P. infundibuliformis* Orb.).

The shell is minute, broadly umbilicate, conic, thin, the whorls (6 in the type species) convex, of small caliber. Aperture small, lateral, oblong, obstructed by a large, deeply entering parietal lamella; peristome expanded and thick. Type *G. infundibuliformis*.

The status of this Bolivian group is uncertain, but the known characters, so far as they go, suggest that it may be a derivative of *Gastrocopta*, either directly related to *Chænaxis* or possibly *Immersidens*, or a modification parallel to the former. If so, it will probably prove to have deeply immersed columellar and palatal teeth. As the type specimens of the only species are lost, these questions must remain in abeyance.

Gibbulina was established by Beck as a subgenus of *Pupa* with the following species:

G. infundibuliformis (d'Orb.).
G. lyonetiana (Pallas).
G. pagoda (Fér.).
G. filosa (Valenc.).
G. inflata (Valenc.).
G. sulcata (O. Müll.).
G. palanga (Fér.).
G. iulus B.
G. palangula (Fér.).
G. modiolus (Fér.).
G. modiolina (Fér.).
G. versipolis (Fér.).

From these, Gray selected the first, *G. infundibuliformis* as type, in 1847. This invalidates the subsequent general use of the name *Gibbulina* for a group of Mascarene *Streptaxidæ*.

GIBBULINA INFUNDIBULIFORMIS (Orbigny). Pl. 28, figs. 5, 6.

Shell very short, conic, thin, striate, provided with a very large, funnel-shaped umbilicus, in which a large part of each whorl may be seen. Spire conic, short, with a rather obtuse summit, composed of 6 swollen whorls, separated by a strongly marked suture. Aperture entirely lateral to the axis, oblong and oblique, provided with a strong tooth or elevated lamella which penetrates into the interior; it is situated on the parietal wall. The margins of the lip are thick and a little reflected. Color, uniform grayish. Length 2.5, width 1.5 mm.

Distribution. — Bolivia, at a place called Pampa Ruis, Province of Laguna, on the last foothills of the eastern slope of the Bolivian Andes, under stones and moss, on precipitous ridges.

Helix infundibuliformis ORB., Mag. de Zool., 1835, p. 21.— *Pupa infundibuliformis* ORB., Voyage dans l'Amérique Méridionale, p. 323, pl. 41 *bis*, f. 7-9. — PFEIFFER, Monogr. Hel. Viv., ii, 331.

This remarkable snail is known only by d'Orbigny's description and figures.

Genus GASTROCOPTA Wollaston.

Gastrocopta WOLLASTON, Testacea Atlantica, 1878, p. 515, for *Pupa acarus* Bens. and *Pupa gorgonica* Dhrn.

Leucochilus BOETTGER, in von Martens, Conchologische Mittheilungen, I, 1881, p. 64. Not *Leucochila* von Martens, 1860.

Bifidaria STERKI, in Pilsbry, Proc. Acad. Natural Sciences of Philadelphia, 1891, p. 315, for *P. contracta* and *P. servilis*. —STERKI, Nautilus VI, p. 4, 1892, and p. 99, 1893.—PILSBRY, Proc. A. N. S. Phila., 1900, p. 590.—DALL, Nautilus XVII, p. 116, 1904, type *B. servilis* Gld.

Includes also *Eubifidaria, Albinula, Vertigopsis* and *Privatula*, Sterki, 1893. *Immersidens* Pilsbry and Vanatta, 1900.

The shell is rimate or perforate, cylindric or ovate-conic, having angular and parietal lamellæ *more or less completely united into one biramose, bifid, lobed or sinuous lamella* (or rarely the angular lamella is wanting). Columellar lamella

present; palatal folds developed (except in *B. corticaria*). Lip well expanded.

The foot is short; tentacles are rather short but distinct. The sole is not divided longitudinally, and in progression shows few muscular waves over its whole width.

Type, *G. acarus* (Bens.).

Distribution, nearly world-wide, in tropical and temperate regions, but wanting in the recent European fauna.

Gastrocopta is essentially a hexodont Pupillid of oblong-conic, subcylindric or ovate shape, in which the angular and parietal lamellæ *converge and are connected by a callus inwardly, or become completely concrescent* into a single sinuous lamella; the shell being small, thin, usually corneous, and without lamellæ in youth.

The affinities of the species are determined by the mode and degree of specialization of the lamellæ and plicæ. Specialization has been in two directions, which might be termed negative and positive:

(1) In some forms the teeth have been reduced in size and number. Thus *Privatula* (*G. corticaria*) has lost the palatal and basal plicæ; in *Vertigopsis* (*G. pentodon*) the lamellæ of the parietal region have degenerated.

(2) In other forms the lamellæ, and more rarely the plicæ, are enlarged and specialized in shape, producing very complicated apertures.

In either series, accessory lamellæ and plicæ may be developed; they have little significance.

Many species of *Gastrocopta* have the shell daubed with dirt, attached by the mucus of the animal. *Bothriopupa* has the same habit, but not our other American genera such as *Pupoides, Pupilla* and *Vertigo*. Species and individuals are most numerous on limestone terranes, or where the rock contains considerable lime, living under stones or wood in grassy, often sunny places, or in the shade on leaves and dead wood. *G. corticaria* is commonly found on the trunks of trees, not far from the ground.

Gastrocopta approaches more nearly to a world-wide distribution than any other genus of the family *Pupillidæ*. If

we include Europe, where species existed from Oligocene to Pliocene times, it inhabits every continent, Polynesia and Hawaii, though in these Pacific islands the few species are apparently importations during the human period. Northward *Gastrocopta* does not quite reach the 53d parallel, falling far short of the northward range of *Pupilla* and *Vertigo*. The absence of species on the American west coast is notable.

NOMENCLATURE.—Species of the genus under consideration formed part of the subgenus *Leucochila* of von Martens (Die Heliceen, 1860, p. 296), which was a heterogeneous group, a species of the genus *Pupoides* being designated as type.

Dr. O. Boettger of Frankfurt, in 1881, was the first to call attention to the composite character of *Leucochila*. We owe to him the first recognition that *Pupa armifera* and its allies form a separate genus, which he proposed to call *Leucochilus*. Zoologists at the present time are not agreed as to whether such names as *Leucochilus* and *Leucochila* are to be considered distinct; many refuse to accept generic terms differing only in gender termination from prior names, while others hold that they are available. Until some consensus of opinion is reached on this point, and a ruling thereon formulated by the International Commission on Zoological Nomenclature, such similar terms are to be avoided.

Leucochilus Boettger has been adopted by most German authors who have treated of the genus. In America the species were left in *Leucochila* Martens until Dr. V. Sterki, in 1891–2, proposed the term *Bifidaria*, which has been used in practically all subsequent American work on the genus.

On account of the impossibility of determining whether *Leucochilus* will eventually be ruled to be a valid name or a homonym, I am reviving the term *Gastrocopta* Wollaston, 1878, which has three years priority over *Leucochilus*. Wollaston seems to have had no adequate idea of the limits or characters of his group; but his first species, *Pupa acarus* Bens., which I select as the genotype, is closely related to the type of *Bifidaria, Pupa servilis* Gld.

AFFINITIES.—In both Asia and America there are several genera having the essential apertural structure of *Gastro-*

copta, but differing by the development of other special features of shape, umbilical region, or the like. They are undoubtedly local or regional derivatives of the old parent genus *Gastrocopta*. In eastern Asia we have *Boysidia* and *Hypselostoma;* in America, *Chænaxis, Bothriopupa*, and perhaps *Gibbulina*, all branches of the *Gastrocopta* trunk. As more remote relatives, collateral genera which probably descended from the same Mesozoic stock as *Gastrocopta*, we may mention *Fauxulus, Odontocyclas* and *Abida* (*Torquilla*).

Palæontologic History.—As fossils, the Gastrocopts are known only in the tertiaries of Europe. In the middle Oligocene of Germany representatives of two subgenera, *Albinula* and *Sinalbinula*, appear, presumably from an Asiatic or Asiatico-American center of dispersal. Both continue in abundance throughout the Upper Oligocene, Miocene and Pliocene, in numerous specific mutations, but without much structural progress. The fossils known throw no light on the origin of the genus, since at least two of its minor divisions had already been characteristically evolved prior to the earliest appearance now known. The origin of the genus must have been far earlier, Eocene or possibly Cretaceous. Further notes, with illustrations, may be found in the section treating of European species.

Dispersal. — The migrations of so old a group as *Gastrocopta* cannot be traced with any degree of certainty until its paleontologic history is better known. It appears likely that the main evolution of the group was in Holarctica, and especially in eastern Asia and North America, whence early emigrants penetrated into Europe and Australia, and later ones into tropical America. In Australia the species remain rather primitive in structure of the parietal and columellar lamellæ, the angular lamella being scarcely or but weakly united with the parietal, even in the specialized group *Australbinula.* None have the wholly concrescent lamellæ of the progressive Pliocene and recent Holarctic forms. This looks like an early Tertiary radiation to that area. In South America the Pupillidæ (*Gastrocopta, Immersidens, Pupoides*) are closely related to those of the Antilles and southern North America,

and in exactly the same stage of evolution, evidently indicating a late Tertiary dispersal over this area.

Excepting the Australian *Australbinula*, all of the highly specialized Gastrocoptoid groups, such as *Hypselostoma, Immersidens, Chænaxis*, and the more complex Albinulas, are in eastern Asia and North America. There seems no reason (and certainly there is no evidence) for believing that any of them arose in parts of the world remote from their present areas.

The chiefly middle and South American and African distribution of the typical (*acarus* and *servilis*) group of *Gastrocopta* is somewhat problematic, and is perhaps traceable to an earlier radiation than the groups considered above. It does not connect readily with the other stocks. In Polynesia the extraordinarily wide distribution of *G. pediculus* and *lyonsiana* seems to me explicable only by the supposition that the former was carried by the Polynesian islanders; it occurs also in Micronesia, Melanesia and the East Indies. *G. lyonsiana* may have been spread later, by nineteenth-century commerce.

Subdivisions of Gastrocopta.—The species will be grouped geographically in the following account, as this is more convenient in practical use than a strictly systematic sequence.

I. North American and West Indian species (nos. 1 to 25).
II. South American species (nos. 26 to 37).
III. East Asiatic species, Japan to Indo-China (nos. 38 to 45).
IV. Species of Western Siberia and Europe (nos. 46 to 64).
V. African and Mascarene species (nos. 65 to 76).
VI. Species of Ceylon, India and the Malay Peninsula (nos. 77 to 85).
VII. Insular species, East Indies, Melanesia, Micronesia, Polynesia, Hawaii (nos. 86 to 94).
VIII. Australian species (nos. 95 to 106).

Subgenera of Gastrocopta.

ALBINULA Sterki. Whitish forms with a palatal callous and palatal plicæ. The inner end of the parietal lamella curves towards the periphery, and (except in *G. holzingeri*) the anterior end is concrescent with the angular lamella. Inner end of the columellar lamella curves downward. Type *G. contracta* (species 1 to 3, 46 to 51).

SINALBINULA Pils. Whitish, with plicæ on a palatal callous. Parietal lamella straight inside, or curving towards the columella, its anterior end usually free, but sometimes the angular and parietal lamellæ are concrescent into a single sinuous lamella. Columellar lamella horizontal, or with the inner end curved downward. Type *G. armigerella* (species nos. 38 to 45, 52 to 65, etc.).

VERTIGOPSIS Ckll. and Sterki. Whitish, with palatal plicæ and usually with a palatal callous. Parietal lamella small, short and straight, the minute angular concrescent with it or wanting. Columellar lamella horizontal or having the inner end decurved. Type *G. pentodon* (species 4 to 7).

AUSTRALBINULA Pils. Whitish forms with palatal plicæ but no palatal callous. Angular and parietal lamellæ diverging in front, the parietal curving towards the columella within. Columellar lamella steeply running upward within. Type *G. rossiteri.*

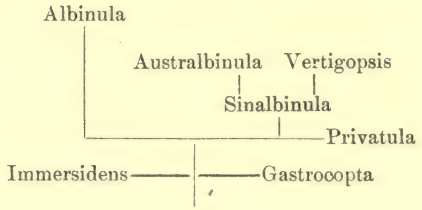
PRIVATULA Sterki. Whitish, without palatal callous or plicæ; angulo-parietal and columellar lamellæ very small. Type *G. corticaria* (species no. 15).

IMMERSIDENS Pils. & Van. Whitish or cinnamon shells with palatal plicæ but no palatal callous. Parietal lamella curving towards the periphery at its inner end, diverging from the angular anteriorly, in form of a reversed letter "y". Columellar lamella horizontal or decurved at the inner end. Basal plica transverse to the cavity when present. Type *G. ashmuni* (species nos. 8 to 14, 34 to 36).

GASTROCOPTA Wall. Whitish or cinnamon shells with palatal plicæ but no palatal callous. Angular and parietal lamellæ concrescent into a single sinuous lamella, which is rarely a little forked anteriorly. Columellar lamella short,

horizontal, or with a callous below the inner end. Palatal plicæ unspecialized, the upper and basal small or sometimes wanting; the basal not subcolumellar in position. Type *G. acarus* (species 16 to 33, 66 to 78, 86, 87).

The interrelations of the subgenera, so far as now understood, may be roughly indicated by a diagram:



I. North American and West Indian Species.

Temperate North America has by far the most diversified *Gastrocopta* fauna of any continent, five subgenera being represented. Three of these, *Albinula, Vertigopsis* and *Privatula*, are notable for their specialization and the small number of species.

Key to Subgenera.

a. Teeth of the parietal wall small or minute.

b. Palatal plicæ present. Subgenus *Vertigopsis*, species nos. 4 to 7.

b^1. No palatal plicæ or callous. Subgenus *Privatula*, species no. 15.

a^1. Teeth of the parietal wall moderately or well developed.

b. Palatal plicæ standing on a white callous; aperture nearly filled by the large teeth. Subgenus *Albinula*, species nos. 1 to 3.

b^1. Palatal plicæ not joined by a callous.

c. Angular and parietal lamellæ diverging forward, the whole like a reversed (mirrored) letter "y". Subgenus *Immersidens*, species nos. 8 to 14.

c^1. Angular and parietal wholly concrescent into a sinuous lamella, or with the parietal projecting very little forward. Subgenus *Gastrocopta*, species nos. 16 to 25.

Keys to the species will be found under the subgeneric heads.

Subgenus ALBINULA Sterki.

Albinula STERKI, Nautilus, vi, 1892, pp. 4, 101, type *P. contracta.*—*Leucochilus* BOETTGER, Conchol. Mittheil., i, 1881, p. 64, type *Pupa armifera.* Not *Leucochila* von Martens, 1860.

Whitish-translucent Gastrocoptas having the *inner end of the parietal lamella curved towards the periphery;* angular lamella well developed, concrescent in varying degree with the parietal; the palatal plicæ stand upon a white palatal callous, and a suprapalatal plica is usually developed. Except in *G. armifera,* the columellar lamella is horizontal in front and curves towards the base within. The lip is thin and expanded.

Type *G. contracta* (Say). Distribution, North America except the Pacific slope; Oligocene to Pliocene of Europe.

If names differing from prior generic terms only in gender are acceptable, *Leucochilus* will replace *Albinula* for this subgenus.

In America, the species of *Albinula* are few and strongly differentiated from one another by the structure of the parietal and columellar lamellæ, which can be seen fully only by breaking away the back or base of the shell. *Albinula* is peculiar by the usual development of a suprapalatal plica; a fold which is never found in *Immersidens* or the typical group of *Gastrocopta.* It is related to *Sinalbinula* and its derivative *Vertigopsis,* but had already been differentiated from these groups in the Oligocene, when the group first appears. The very small number of recent species of *Albinula* (3), and the fact that in Europe the group became extinct after a long series of mutations without much structural change, probably indicates that the subgenus is relatively inflexible and inadaptive, and now nears final extinction; yet two of the recent species are widely spread and abundant snails in eastern North America.

Immersidens and *Gastrocopta* (restricted) extend from the

warm temperate parts of North America across the tropics to Argentina, while *Albinula* has not penetrated into South America. The two or three Mexican forms of *Albinula* and *Vertigopsis* are northern species which have apparently migrated southward rather recently, as they have not been differentiated from the northern stocks.

Known Albinulas are from two widely separated regions, eastern North America and central and western Europe. These may be looked upon as the extreme eastern and western herds of an *Albinula* stock once (Lower Oligocene or earlier) spread over western America and northern Asia, regions where it is now extinct. As we would expect in so ancient a group, the few recent species are structurally isolated, representing the termini of as many collateral phyletic series. The groups are as follows:

Series of G. armifera (species no. 1). Recent, eastern North America.

Series of G. quadriplicata (species nos. 46 to 51). Middle Oligocene to Pliocene, Europe.

Series of G. contracta (species no. 2). Recent, eastern North America.

Series of G. holzingeri (species no. 3). Recent, eastern North America.

Key to American Species.

a. Angulo-parietal lamella with lobed, sinuous edge, not much bent and not forked anteriorly; shell large, 3.3 to 4.5 mm. long. *G. armifera*, no. 1.

a[1]. Angulo-parietal very long, bent L-shaped; shell ovate-conic, 2.3 to 2.5 mm. long. *G. contracta*, no. 2.

a[2]. Angulo-parietal lamella forked in front; shell cylindric, about 1.75 mm. long. *G. holzingeri*, no. 3.

Series of G. armifera.

The *armifera* group is distinguished by its large, oblong shell and the columellar armature. There is a thick, obliquely descending or protractive lamella on the axis, which recedes again towards the base (pl. 1, fig. 3). This is variously modified in the several races. Sometimes the forwardly descend

ing portion is strongly developed, as in *clappi* (pl. 1, figs. 7-9), and again the descending portion may be very much reduced, and the retracted lower limb emphasized, as in *abbreviata* (pl. 2, fig. 3); the last approximating somewhat to the structure of typical *Albinula* (pl. 2, fig. 12, *G. contracta*).

The angular lamella is sigmoid and entirely concrescent with the anterior end of the short, nearly straight parietal (pl. 1, fig. 2; pl. 2, fig. 2). There is a weak or well-developed lateral callous on the peripheral side of the parietal at its inner end, homologous with the lateral bend in *G. contracta*, or there may be the very weak trace of such a bifid structure as I have figured for *G. dupuyi*. This is best shown in pl. 1, figs. 2 and 11.

Gastrocopta armifera and its allies, we may conclude, are related to *G. contracta*, but are less specialized, retaining more of the structure of European Tertiary species.

1. Gastrocopta armifera (Say). Pl. 1, figs. 1 to 4.

The shell is perforate and rimate, oblong, the summit obtusely conic; thin, paraffine-white, glossy, weakly marked with very oblique, irregular growth-striæ. Whorls about 6½, moderately convex, the last compressed around the axis. Aperture irregularly rounded. Peristome thin, well expanded, the margins approaching, often (and typically) connected by a short callous with raised edge across the parietal wall. Angular lamella joined to the outer lip near its insertion, united with the parietal lamella, its summit projecting as a short spur on the right side. The columellar lamella, as seen in a shell broken to show the interior (figs. 3, 4), is subvertical, advancing slightly downward, then retracted towards the base; giving off a short, horizontal branch in front, and visible in the aperture. Basal lamella is low and often inconspicuous. Palatal plicæ stand upon a white callous; lower palatal plica short, entering, the upper one shorter; a small suprapalatal tubercle stands above it.

Length 4.4, diam. above aperture 2.2 mm.

Pupa armifera Say, Journ. Acad. Nat. Sci. Phila., II, p.

162, 1821. BINNEY, Man. Amer. Land Shells, p. 325, 1885.—GOULD, Boston Journal Nat. Hist., iii, p. 400, pl. 3, f. 10.—PFR., Monogr. Hel. Viv., ii, 357, vi, 329.—*Bifidaria armifera* Say, STERKI, Nautilus, xiii, 1909, p. 52, with var. *interpres* (p. 52), and varr. *similis, affinis* and *abbreviata* (p. 53).—WALKER, Occ. Pap. Mus. Zool. Univ. Mich., No. 15, 1915, pp. 5, 9, 10.—*Pupa armigera* Say, POTIEZ ET MICHAUD, Galerie des Mollusques, i, 1838, p. 159, pl. 16, f. 1, 2 (Pittsbourg).—BINNEY, in Warren's Prelim. Rep. on Expl. in Nebraska and Dakota in the years 1855-57, reprint, 1875, p. 107 (Fort Berthold).

Eastern United States and Canada: Quebec to northern Florida, west to Red Deer, Alberta, Dakota, near Boulder, Colorado, Lincoln Co., New Mexico, and the mouth of the Pecos River, Texas. Type locality, Pennsylvania; type no. 11624 A. N. S. P.

This species is easily recognized by its large size, oblong shape, the spermaceti or paraffine tint and large teeth. In life the shell is daubed with dirt. It inhabits almost the whole country east of the continental divide, but is lacking in southwestern New Mexico, southern Texas, southern Florida, and the higher parts of the Alleghany Mountain system. It prefers limestone districts.

This is much the largest *Gastrocopta* known. Say's types were not located more exactly than "Pennsylvania". Pl. 1, fig. 1 is the type specimen. I select Germantown, Philadelphia, as the type locality, the specimens from there agreeing exactly with Say's. The columellar lamella, as seen in a view in the back (pl. 1, fig. 3), is most prominent at the lower third. From this prominence a short horizontal branch runs forward (pl. 1, fig. 4), below which the lamella recedes. The peristome is either continued as a thread across the parietal wall, or the interruption is short. The usual variation in size, in the type locality, is from 4 to 4.6 mm. long, 2 mm. wide above aperture. The short individuals, having about the same diameter as the long ones, are quite different in contour, being oval, while the long shells are cylindric.

The basal fold is sometimes distinct, though low, as in pl.

1, figs. 3, 4, but usually it is less conspicuous, as in fig. 1. Shells agreeing well with the types are to be found over nearly or quite the whole range of the species, but there are also several incipient races which have been defined by Dr. Sterki. The most tangible differential features of these races are found in the shape of the columellar lamella, of which comparable views are given on pl. 1, figs. 3, 9, 11, and pl. 2, fig. 3. The small differences in details of the palatal plicæ, shown in the several face views, are not of much significance, since these plicæ are somewhat variable in most lots.

1*a*. Form *interpres* Sterki.

"Near the typical form, generally somewhat slender; inferior columellar lamella rather high up; the base is narrow inside and more keel-like outside; the aperture is narrowly rounded at the base, and from this feature specimens are easily recognized. More than any other form this shows clearly that the so-called 'basal' is really an inferior columellar.

"Distribution: Southern, especially southwestern; it appears to be the prevalent form in Kansas, Arkansas, Oklahoma, and thus represents a geographical variety" (*Sterki*).

This form is so intimately related to the typical *armifera* that I am unable to segregate it.

1*b*. Form *similis* Sterki. Pl. 1, fig. 6.

"Averaging somewhat smaller; more cylindrical, often more or less conical; whorls less convex; surface striæ slighter; shell generally more milky-whitish, as noticed especially when a number of each, *armifera* and *similis*, are placed side by side; peristome never continuous, somewhat less everted; the columellar lamella is slighter, generally more protracted downward, the lower palatal is shorter, sometimes quite short; the spur of the parietal is larger" (*Sterki*).

Distribution. — Northern New York to Iowa, Minnesota, Ontario.

This is very close to *armifera*, the columellar lamella being practically the same in form, but the margins of the peristome are separated rather widely above. Figured from a paratype from Rose Hill, Ontario, the type locality.

1*c*. Form *affinis* Sterki. Pl. 1, fig. 5.

"Somewhat small and slight; near *similis*, but less cylindrical, rather somewhat oblong; whorls 6-6½, somewhat more convex than in *similis*, the last rounded at the base and little flattened over the palate, with none or a slight scar over the lower palatal plica; aperture somewhat rounded, peristome never continuous; parieto-angular lamella well connected with the peristome, spur of the parietal larger than in typical *armifera;* columellar nearly axial, a broad lamella, reaching down to the base, with distinct lines of growth, visible from the outside through the (fresh) shell below the umbilicus, as in *B. contracta;* inferior columellar [basal fold] wanting or small; lower palatal quite short, or even a transverse, short, abrupt lamella. Alt. 3.5 to 4, diam. 2.2 to 3 mm.

"Distribution: Northern Ohio, Michigan, Indiana to Minnesota and Kansas; seems rather scarce in the first-named states, common in Kansas. Found on sandy dunes on Lake Erie in Ohio.

"It is notable and significant that both the columellar and the lower palatal in this form are of the same shape as in *B. contracta*, while in typical *armifera* they are quite different, yet the latter shows a tendency to having the peristome continuous, while in *affinis* its ends are always apart" (*Sterki*).

The lobe of the columellar lamella is rather thin, abrupt above, and the forward branch is almost obsolete. Difficult to distinguish from the typical form and form *similis*. Figured from a paratype.

1*d*. G. ARMIFERA ABBREVIATA (Sterki). Pl. 2, figs. 1, 2, 3.

"Averaging rather small, slight, somewhat fusiform to ovate or cylindro-conical; apex low, conical or rounded; whorls only 5½-6 (rarely 6½), little convex, with the penultimate comparatively broader than in the other forms, the last rounded at the base, slightly flattened over the palate; color somewhat milky-whitish; surface with a dullish gloss, striæ fine and slight; aperture somewhat small; peristome moderately everted, its ends (in most forms) comparatively

far apart; lamellæ and plicæ: parieto-angular, not or slightly connecting with the peristome, spur small; columellar rather as in typical *armifera*, but smaller, slighter; inferior columellar [basal fold] tooth-like, placed obliquely, more constant than in other forms as to size, shape and position; lower palatal regular but slight, often rather short; suprapalatal rather constant.

"Alt. 3.3 to 3.8, rarely 4 to 4.2, diam 1.9 to 2.2 mm.; some specimens are low, almost globular, alt. 3.2, diam. 2.1 mm.

"Numerous specimens seen from Bismarck, North Dakota; Eastport, Iowa (Missouri River drift); Lincoln, Nebraska; Nickerson, Kansas" (*Sterki*).

This is a common shell in North and South Dakota, also in eastern Colorado (Trinidad, *Pilsbry*), and southward to near Las Vegas, New Mexico (rocky ledges along the Gallinas River, *Cockerell*), Val Verde Co., Texas, in drift of the Pecos River, near the High Bridge (*Pilsbry and Ferriss*), and to Caddo Parish, Louisiana (*C. B. Moore*). It can be more easily identified than the preceding forms, by the quite short lobe of the columellar lamella (pl. 2, fig. 3), placed low on the pillar, its ascending limb very low, and by the usually larger development of the basal tubercle (inferior columellar of Sterki). The columellar lamella has a short forward branch, as in typical *armifera*, and in shape approximates to the *contracta* type more than in other subspecies of *armifera*.

1*e*. G. ARMIFERA RUIDOSENSIS Cockerell. Pl. 1, figs. 10, 11.

The teeth are more massive than in the typical or any of the preceding forms, making the orifice much narrower. Columellar lamella large and thick, having a triangular outline as seen from the back (pl. 1, fig. 11), the highest part being the receding lower lobe. Length 4, diam. above aperture 2 mm.

New Mexico: Blackwell's ranch, Ruidoso, the type (no. 73944, A. N. S. P.) from an anthill (*C. M. Barber*). Also Gallinas canyon (*T. D. A. Cockerell*).

Bifidaria armifera var. nov. *ruidosensis* COCKERELL, Nautilus, XIII, July, 1899, p. 36.

The type is drawn in fig. 10, a specimen from Gallinas canyon in fig. 11.

1*f*. G. ARMIFERA CLAPPI (Sterki). Pl. 1, figs. 7, 8, 9.

"Shell glossy, colorless to milky-whitish, perforate, cylindrical in the lower 3 to 4 whorls, conical or subconical above, with a rather acute apex; whorls 6½ to 7½, the upper ones rather narrow, the lower ones broader and less convex, the last moderately large, ascending at the aperture, somewhat narrow but rounded at the base, slightly flattened over the palate; surface shining, with slight irregular to subregular striæ; aperture nearly oval, margins approximate; peristome everted, not thickened, but there is a slight to rather strong white callous in the palate; lamellæ and plicæ: parieto-angular distinctly complex, rather long, moderately elevated, connecting with the peristome near its outer upper terminus (much as in *B. armifera*), the spur of the parietal moderately large; columellar axial spiral, with the lower end nearer the aperture, thicker and rather abrupt, or somewhat bifurcate; 'basal' (inferior columellar) slight or wanting; upper and lower palatals regular, an interpalatal in many specimens; suprapalatal wanting or quite small. Alt. 3.5 to 4 (rarely 3.2 to 3.4), diam. 1.9 to 2.1 mm.; aperture alt. 1.5, diam. 1.2 mm.

"Soft parts, seen only from one dried Alabama specimen, soaked, very dark from copious, deep brown pigment. Jaw amber-colored, strongly curved, rather broad, rounded at the ends, its surface with numerous radial rib-striæ; the line of the attachment of the tenaculum strong. Radula with 78 transverse rows of 27 (or 29) teeth, r + 6 + 7 (8); rachidian rather narrow, with a short mesodont and very small ectodonts (barely visible); laterals bicuspid, with the mesodont as long as the plate, the ectodont about one-third as long; the outer posterior angle of the plate raised, cusp-like; seventh and eighth with the ectodont split in two, somewhat intermediate or 'transition' teeth; marginals (9–13) serrate, with the mesodont rather long, thin; the fourteenth a barely visible irregular transverse bar, or wanting. As this

is from a single specimen, there may be some variation. Other parts could not be examined'' (*Sterki*).

Distribution.—Tennessee: Knoxville (type loc., Mrs. Geo. Andrews); Fayetteville (B. Walker coll.); Columbia (B. Shimek, A. A. Hinkley). Alabama: Gurley and Huntsville (H. H. Smith). Michigan: Grand Rapids (B. Walker). In most lots it was associated with *G. armifera.*

Bifidaria clappi Sterki, Nautilus, XXII, Feb. 1909, p. 108, pl. 8, fig. 4.

The chief differential character of this race is in the shape of the columellar lamella. In a profile view (pl. 1, fig. 8) it is seen that the plane of the lamella is straight very nearly to the base, while in *armifera* the greatest projection forward is well above the base. The anterior branch of the columellar lamella, which is more or less apparent in *armifera*, is wanting in *clappi*, being concrescent with the lower end of the main lamella (compare figs. 4 and 8). In view of the variability of the columellar lamella in *armifera*, it does not appear to me that this small modification is of specific importance. Figured from co-types, one of which (fig. 7) served for the original figure of the species (no. 98279, A. N. S. P.).

Dr. Sterki writes: ''The species shows little variation, except in altitude, with nearly the same diameter, and such as are noted in the description. There is no tendency towards having the peristome continuous. . . . *B. clappi* is remarkable for its resemblance to some forms of *B. armifera* Say, for a variety of which it has been taken. Yet it is quite distinct. Of over 150 specimens carefully compared with more than 1500 *armifera*, not one was found doubtful or intermediate. The most tangible difference is in the shape of the columellar lamella. The shell averages somewhat smaller, the apex is more acute, the surface striæ are finer and slighter, the lower palatal plica is always regular.''

Series of G. contracta.

The angular and parietal lamellæ are completely concrescent, the parietal being abruptly bent towards the periphery within, and usually has a low, further continuation inward; inner end of the columellar lamella curving down.

G. contracta is the most specialized species of *Albinula*, and has no near relatives among known forms, either recent or fossil. The European Tertiary species are more nearly related to *armifera* than to *contracta*.

2. GASTROCOPTA CONTRACTA (Say). Pl. 2, figs. 9, 10, 11, 12.

The shell is rimate, ovate-conic, tapering from the last whorl to the obtuse apex, bluish-milky or spermaceti-colored, imperfectly transparent, glossy, marked with fine growth-striæ. Whorls 5⅓, very convex, the last half of the last whorl straightened, pinched at the base, impressed over the lower palatal plica, and on both sides of a low rounded ridge which stands a short distance behind the peristome (fig. 11). Aperture rounded-triangular, almost closed by large teeth. Angulo-parietal lamella joining the lip, angularly bent to the right near the middle, then abruptly becoming much lower and bent inward (pl. 2, fig. 9). Columellar lamella large, thin, very deeply placed, subvertical, the upper end curving forward (fig. 12). A subvertical callous stands in front of it, near the margin (fig. 12).

Palatal plicæ two, connected by a low callous, the lower one obtuse, transverse, more deeply placed and larger than the tuberculiform upper plica. Peristome thin, well-expanded, continuous.

Length 2.5, diam. 1.4 mm.

Length 2.3, diam. 1.3 mm.

Eastern United States and Canada: Maine, Ontario and Manitoba, south to Miami, Florida, and Vera Cruz, Mexico; Jamaica. Type locality, Occoquan, Virginia.

Pupa contracta SAY, Journal of the Acad. Nat. Sci. Phila., ii, p. 374, 1822.—C. B. ADAMS, Contrib. to Conch., no. 9, p. 184 (Jamaica).—PFEIFFER, Monographia Hel. Viv., ii, 356; vi, 327; viii, 397.—BINNEY, Terrestrial Mollusks, v, p. 207, pl. 70, f. 2.—*Bifidaria contracta* (Say), PILSBRY, Nautilus, xi, 1898, p. 117.—WALKER, Occ. Pap. Mus. Zool. Univ. Mich., no. 15, 1915, pp. 9-11.—*Pupa deltostoma* Charpentier, KUESTER, Syst. Conch. Cabinet, *Pupa*, 1852, p. 181, pl. 21, f. 17–19. —? *Pupa nebraskana* W. G. BINNEY, in Warren's Prelim.

Rep. on Expl. in Neb. and Dak., in 1855–57, reprint, 1875, p. 107 (Ft. Berthold; name only).—"*Pupa nebrascana* Warren's Rep. of Surveys, etc., Ex. Doc., ii, pt. 2, 35th Cong., 1859, p. 725"; W. G. Binney, Terrestrial Moll., v, p. 213 ("may perhaps be *P. contracta*").

This species is readily known by the conic shape, and peculiar aperture, nearly closed by the large teeth. There is some variation in the shape, some individuals being more shortly conic than that figured. Also in the prominence of the low ridge or crest behind the outer and basal lips, which varies from strong to very weak.

Its western limit, as represented in the collection of the Academy, is Clay Co., South Dakota, Payne Co., Oklahoma, and mouth of the Pecos River, Val Verde Co., Texas. Southward it extends over peninsular Florida in a slightly different race, but has not occurred on the keys of the southern and eastern coast.

In the higher parts of the Alleghany Mountains, *G. contracta* seems to be rare, if not absent.

In Mexico specimens are in the collection of the Academy from Tampico, Tamaulipas; several places in eastern San Luis Potosi; Yautepec, Morelos; Texolo and near Orizaba, State of Vera Cruz; the specimens collected by A. A. Hinkley, S. N. Rhoads and the Heilprin expedition.

In Jamaica *G. contracta* was found by C. B. Adams prior to 1850, and subsequently it was taken in the interior of St. Anne (C. P. Gloyne, Journ. de Conch., xxiii, 1875, p. 121), near Hope Bay (H. Prime, in Henderson coll.) and on Swift River (C. W. Johnson). Specimens from all these lots have been examined. Possibly it was introduced on plants from the mainland, Mexico or the United States, as the species seems an alien in the Jamaican fauna; yet its occurrence in several localities is against this view. I cannot see that the Mexican and Jamaican specimens differ in any way from those of the United States. It is a wonderfully constant species.

2*a*. Form *peninsularis*, n. f. Pl. 2, fig. 8.

The shells of peninsular Florida are slightly more fragile than the typical form, and differ by having the inward continuation of the parietal lamella, beyond the second angular bend, much lower and often detached from the rest of the lamella. Figured type is from Crystal River, Citrus Co., Florida.

2*b*. G. CONTRACTA CLIMEANA Vanatta. Pl. 3, figs. 1, 4.

"Shell similar to typical *contracta* (Say), but the parietal tooth lacks the inner continuation, being L-shaped (fig. 4). Alt. 2.29, diam. 1.43 mm." (*Vanatta*).

Southern United States: Gulf coastal plain from Alabama to Texas, and lowlands of the Mississippi north to Arkansas. Alabama: Blakeley and Simpson Island, Baldwin Co. (*C. B. Moore*); Calera and Wetumpka (*H. H. Smith*). Mississippi: Anderson Landing, on the Sunflower River near confluence with the Yazoo, Sharkey Co. (type loc.), and O'Neil Landing, Yazoo Co. (*C. B. Moore*). Louisiana: New Orleans (*S. N. Rhoads*), Franklin and Morehouse Parishes (*C. B. Moore*). Arkansas: Ashley and Arkansas Counties (*C. B. Moore*). Texas: Navidad River bottom, Jackson Co. (*J. D. Mitchell*).

Bifidaria contracta climeana Van., Proc. A. N. S. Phila., 1911, p. 525, f. 1–3.

In its area this subspecies replaces *G. contracta*. The Floridian form (*peninsularis*) in which the inner continuation of the parietal lamella is weak or interrupted, forms a partial transition between *contracta* and *climeana*.

Series of G. holzingeri.

The inner end of the parietal lamella curves strongly towards the periphery, and its anterior end is produced forward of the junction with the angular lamella, the two lamellæ diverging forward, the whole, when viewed from the base, shaped like a mirror image of the letter "y". Columellar lamella thin, high, and curving down at the inner end. Palatals on a callous ridge, as usual.

The separation of parietal and angular lamellæ anteriorly

is a primitive feature; otherwise the lamellæ are rather highly specialized.

3. GASTROCOPTA HOLZINGERI (Sterki). Pl. 2, figs. 4, 5, 6.

"Shell narrowly perforated, turreted-cylindrical, vitreous (or whitish), very minutely striate, shining; apex rather pointed, whorls 5, regularly increasing, well rounded, especially the upper ones, the last somewhat narrowed and a little ascending towards the aperture, compressed at the base but not carinated, at some distance from the outer margin provided with an oblique, rather prominent, acute crest corresponding in direction to the lines of growth, extending from the base to the suture, formed by a whitish callosity; behind the crest the whorl is flattened, and corresponding to the lower palatal lamella, impressed. Aperture lateral, scarcely oblique, relatively small, inverted subovate, with a slight sinus at the upper part of the outer wall, margins approximated; peristome moderately reflected; lamellæ 6: one parietal, rather long, very high, in its middle part curved outward, towards the aperture bifurcated, the outer branch [angular lamella] reaching the parietal wall; one columellar, longitudinal, rather high, its upper end turning in nearly a right angle towards the aperture, but not reaching the margin; basal exactly at the base, short, high, dentiform; 3 in the outer wall, viz.: the lower palatal long, ending in the callous, highest about its middle; the upper short, rather high on the callous; above the upper one a suprapalatal, quite small, dentiform, nearer the margin. Length 1.7, diam. 0.8 mm." (*Sterki*).

United States and Canada: Ontario and western New York to Helena, Montana, south to Illinois, Kansas, and Albuquerque and Mesilla, New Mexico.

Pupa holzingeri STERKI, Nautilus, iii, August, 1889, pp. 37, 96, 119; Proc. A. N. S. Phila. for 1889, p. 414, pl. 12, f. 4–7. —BINNEY, 3d Suppl. to Terr. Moll., v, p. 93, text figure.—WALKER, Nautilus, v, p. 93 (Put-in-Bay Island, Lake Erie); Occ. Pap. Mus. Zool. Univ. Mich., Nov. 15, 1915, pp. 4–9 (San Miguel Co., N. M.).—PILSBRY, Nautilus, xiv, p. 83.—*Bifidaria*

holzingeri var. *fordiana* STERKI, Nautilus, vi, 1892, p. 4 (nude name).—*Bifidaria agna* PILSBRY and VANATTA, Nautilus, xx, 1907, p. 140, figs. 1–3.

G. holzingeri differs from *G. contracta* by its nearly cylindric shape, the presence of a strong basal fold, the small size, and discontinuous peristome. The columellar lamella (fig. 6) ascends the axis and towards the upper end curves forward almost exactly as in *G. contracta.* It differs from both *contracta* and *armifera* by the shape of the angulo-parietal lamella, which is forked in front, and in a basal view has the shape of the Greek letter λ, as in the subgenus *Immersidens* (pl. 2, fig. 4). The palatal callous and armature, however, are typical for *Albinula.*

It is not an uncommon species in Illinois and Iowa; found also in Minnesota (Winona), Dakota, Nebraska, etc.

3*a*. *G. holzingeri agna* Pilsbry & Vanatta. Pl. 2, fig. 7.

The shell is rimate, cylindric, the last three whorls of about equal diameter, the summit very obtuse; surface nearly

Figs. 9–11. *Gastrocopta holzingeri agna.*

smooth; of a spermaceti-whitish color. There are 4¾ convex whorls, the last with a strong rounded crest behind the outer lip, rather close to it above, but being more oblique, it is further behind the lip at the base. Behind the crest the whorl is a little flattened laterally, and shows the lower palatal plica through as a white spot. The aperture is brought forward nearly in line with the ventral convexity of the whorls. The

peristome is thin, slightly expanded, strengthened a short distance within wth a low callous rib. The parietal lamella appears distorted and angular in front view; seen from the base it is seen to consist of an angular and a parietal lamella, completely united inwardly. The columellar lamella is thick and slants upward from within. The basal fold is strong, arising on the callous but extending inward beyond it. The lower palatal fold is large and pliciform, more or less immersed, standing chiefly inward from the palatal callous. The upper palatal fold is much smaller, and stands rather near the lower, upon the palatal callous. There is a small or minute suprapalatal fold, also on the callous.

Length 1.75, diam. 1 mm.

Trinidad, Colorado, type no. 93052, A. N. S. P. (figs. 9, 10; pl. 2, fig. 7). Also Silver Lake, Kansas (fig. 11).

This race differs from *G. holzingeri* by its more slender, cylindric shape and the form of the columellar lamella, which ascends straightly and runs forward (pl. 2, fig. 7), while in *holzingeri* it ascends further and has an arched shape.

Subgenus VERTIGOPSIS 'Cockerell' Sterki.

Vertigopsis Ckll. MS, STERKI, Nautilus, vi, 1892, p. 4; p. 101, 1893, type *P. curvidens* Gld.

Vertigopsis differs from *Sinalbinula* chiefly by the weakness of the parietal lamellæ, the angular being very small or wanting, and the parietal short and simple.

It is not directly related to other American groups of the genus, having evidently been derived from the Asiatic section *Sinalbinula*.

The species are illustrated on plates 3, 4 and 5.

Key to Species.

a. With a distinct palatal callous.

b. Shell ovate-conic, usually with 7 teeth; length 1.7 to 2 mm. *G. tappaniana*, no. 5.

b[1]. Shell oblong-conic or cylindric.

c. Oblong-conic, with 5 to 8 teeth; 1.5 to 1.8 mm. long. *G. pentodon*, no. 4.

c[1]. Cylindric, with 5 teeth. *G. p. gracilis*, no. 4*a*.

a^1. With no distinct palatal callous.

b. Ovate-conic, with 4 to 5 teeth; 1.2 x 1 mm.
G. carnegiei, no. 6.

b^1. Cylindric, with 5 teeth; 1.6 to 1.9 mm. long.
G. pilsbryana, no. 7.

4. GASTROCOPTA PENTODON (Say). Pl. 3, figs. 2, 3, 5 to 8; pl. 4; pl. 5, figs. 28 to 41.

The shell is rimate, oblong-conic with obtuse summit, clear corneous or whitish, smooth. Whorls 5, convex, the last with a rounded ridge or crest (low or well developed) close behind the lip, and flattened near the base behind the ridge. Aperture short, truncate-oval. Teeth typically five, the angulo-parietal lamella almost simple and straight, columellar lamella thin, horizontal; the palatal plicæ stand upon a low callous ridge, the lower plica compressed and entering a little more deeply than the smaller, tuberculiform upper one. Accessory denticles are usually developed in the subcolumellar, basal and interpalatal positions. The peristome is thin, narrowly expanded, with a thin, straight, parietal callous between the widely separated ends.

Length 1.8, diam. 1.1 mm.

Length 1.7, diam. 1 mm.

Length 1.5, diam. 0.8 mm.

Eastern United States and Canada: Prince Edward and Magdalen Islands to Alberta, south to central Florida and Texas; New Mexico; west in Arizona to the Santa Cruz River. Eastern Mexico and Guatemala. Type locality, Pennsylvania.

Vertigo pentodon SAY, Journal Acad. Nat. Sci. Phila., ii, 1821, p. 376.—*Pupa pentodon* (in part) BINNEY, Terrestrial Mollusks, v, 1878, p. 200.—PFEIFFER, Monogr. Hel. Viv., ii, 359; iii, 557; iv, 684; vi, 330; viii, 402.—*Bifidaria pentodon* Say, PILSBRY and VANATTA, Nautilus, xix, p. 121, pl. 6, 7, figs. 1 to 41. — WALKER, Occ. Pap. Mus. Zool. Univ. Mich., No. 15, 1915, pp. 9–11.—*Pupa curvidens* GOULD, Report on the Invertebrata of Massachusetts, 1841, p. 189, fig. 120.—*Pupa cincinnatiensis* JUDGE, The Quarterly Journal of Con-

chology, 1878, p. 343. — *Pupa montanella* COCKERELL, The Journal of Conchology, Leeds, vi, 1889, p. 63; British Naturalist, 1891, p. 101.—*Pupa curvidens* GOULD, Invertebrata of Massachusetts, 1841, p. 189, f. 120.—*Pupilla floridana* DALL, Proc. U. S. Nat. Mus., viii, 1885, p. 261, pl. 17, f. 11.—*Pupa curvidens* var. *gracilis* STERKI, Nautilus, iii, 1890, p. 119; Land and Fresh-Water Mollusca in the Vicinity of New Philadelphia, 1894, p. 5.

This widely-spread species may be recognized by the small size, spermaceti or bluish-white color and simple parietal tooth, with lip-teeth arranged on a white callous rim. It is most easily obtained by dirt or leaf sifting. It lives on wooded hillsides or in well-drained groves among leaves in the underbrush; also "is common among moss and grass in forest and on open slopes."

The variations in shape and teeth are shown in plates 4 and 5, figs. 1-41. Pl. 3, figs. 2, 3, 5, and pl. 4, fig. 1, are typical *pentodon*, which has 5 teeth. The parietal lamella "is really composite, that is, composed of the parietal and the angular, although the latter is generally quite small, a mere appendage of the former. In many specimens of *pentodon* it is quite distinct (see pl. 3, fig. 6; pl. 4, figs. 3, 12, 21, 27; pl. 5, fig. 32), and in some the whole lamella is even bifid, somewhat like that of *B. holzingeri*" (*Sterki*). More commonly, and typically, the angular lamella is wanting, or so small that it is not distinguishable from the parietal (pl. 3, fig. 2). The columellar lamella descends spirally (pl. 3, fig. 5).

Pl. 4, figs. 1 to 8 are from Maine specimens, showing the ordinary variations. The development of a crest behind the lip varies a good deal, from weak to very strong, with all intergrades.

P. cincinnatiensis (pl. 5, fig. 35, a cotype) is merely a small form of *pentodon*. It is described as having the "peristome simple, heavily thickened near the margin, the callous extending over the parietal wall; aperture contracted by five prominent denticles, seated on the callous, one prominent on the parietal wall, two on the columella, the lower being the smaller of the two, and two on the outer portion of the peri-

stome, more deeply seated in the throat, and occasionally one or two very minute rudiments on the peristome. Length 1.56, diam. .84 mm. This shell is found on both sides of the Ohio River, near Cincinnati.'' (*Judge*, The Quarterly Journ. of Conch., p. 343, 1878.)

The increase in number of accessory denticles or teeth culminates in the form named *curvidens*, represented in pl. 4, figs. 9 to 15, also pl. 5, figs. 3, 6, 32, and perhaps some others, as there is absolutely no line to be drawn between *pentodon* and *curvidens*. The number of teeth varies from 5 to 9 in perfectly adult shells of the same gathering from one spot. Gould's type had 9 teeth. It was from Phillips Point, Lynn, Massachusetts. Pl. 3, figs. 6 (Ocean City, N. J.), and 7, 8 (Troy, N. Y.), are good examples of the form *curvidens*.

It may be stated as proven that some colonies consist of ''pentodon'' and intermediate forms; some of ''pentodon,'' intermediate and ''curvidens'' forms; and some of the intermediate and ''curvidens'' forms. We have found no large gathering of wholly typical *pentodon* or entirely *curvidens*. Either form may be found with a low or high crest—this being usually more constant in any one colony than the number of teeth or the size and shape of the shell. The only theory upon which *curvidens* could be retained as a species or subspecies would be to assume that two species are living in a state of hybridism.

The development of an infraparietal denticle is extremely variable in many lots, as in that from Buckfield, Me., pl. 4, figs. 1 to 4, 8. This infraparietal tubercle is exactly comparable to that of some Eastern species, such as *G. armigerella* of Japan and China. It is not found in other American Vertigopsis, though occasionally developed in the typical section of *Gastrocopta*.

P. floridana (pl. 4, fig. 9, a cotype from the author) is absolutely identical with *curvidens*. It is described as ''subcylindrical, . . . teeth about 9, of which there are generally 3 larger than the rest, their tips nearly meeting and their bases mutually nearly equidistant; one is on the pillar, one on the body-whorl, and one on the anterior margin; on either

side of the latter are two generally subequal, much smaller denticles. Lon. 1.6, lat. .75 mm. Archer, Alachua Co., Fla." (*Dall*, Proc. U. S. Nat. Museum, vol. 8, 1885, p. 261, pl. 17, f. 11.)

The figure seems to have two teeth on the parietal wall, two on the columella and five in the palatal region. This is practically identical with the arrangement described under *curvidens*.

Since no definition of any kind has been published, *P. montanella* Ckll. becomes an absolute synonym of *B. pentodon*. The following notices of it have appeared:

"*Pupa montanella*. A minute *Leucochila* which I have found very sparingly at about 8400 feet in West Custer Co. (Colorado), to which I have given the name *P. montanella* sp. nov., but do not describe it pending further investigations." (*Cockerell*, The Journ. of Conch., Leeds, vol. vi, 1889, p. 63.)

"*P. montanella*, indicated on the same page as *P. coloradensis*, proves to be a form of *P. pentodon*." (*Cockerell*, The Brit. Naturalist, 1891, p. 101; re-affirmed also in Univ. of Colo. Studies, iv, p. 171.)

In Mexico I have seen *G. pentodon* from a canyon four miles west of Victoria, Tamaulipas (S. N. Rhoads), and bluffs north of San Dieguito, S. L. Potosi (A. A. Hinkley). In Guatemala it was found by Mr. Hinkley at Jocolo. The specimens are typical. These localities show that the species has an extraordinary zonal range. It is found over a greater area than any other North American *Gastrocopta*.

4*a*. *G. pentodon gracilis* (Sterki). Pl. 4, figs. 16 to 27.

"On a gravelly bank at New Philadelphia, Ohio, there is a peculiar form of our species; long, slender, nearly cylindrical, with only 5 typical lamellæ, no accessory ones" (*Sterki*, 1890).

"*Pupa curvidens gracilis* Sterki. Scarce. New Philadelphia. A peculiar form intermediate in shape between the type and *Pupa holzingeri* Sterki. It has also been seen from Rhode Island, Tennessee and Alabama" (*Sterki*, 1894).

This is usually larger, more cylindric, with 5 teeth, though perfectly mature shells may have as few as 3 (figs. 19, 26) or as many as 6 or 7 (figs. 16, 18, 21). It was originally described from New Philadelphia, Ohio, but those figured are from Alabama; figs. 16, 17, 21 to 27 from around Wetumpka; 18, 19 from Woodville; 20 from Big Wills Valley, coll. by H. H. Smith and H. E. Sargent. None of them has an infraparietal denticle.

While this race seems to be tangibly differentiated in the hill region of Alabama, specimens may be selected from other lots of *pentodon* which could not possibly be distinguished if mixed with the Alabama shells; for instance, fig. 31, Henry Co., Indiana, and fig. 33, Des Moines, Iowa, both taken from lots varying in shape from long and cylindric to shorter and more conic.

The specimens of *G. pentodon* and varieties figured are from the following localities:

NOTE.—The figures are all drawn to one scale (× 13.8), and any may be accurately measured by plotting on paper a scale with the lines 13.8 mm. apart; each space then representing 1 mm. Thus fig. 1 is 1.8 mm. long.

PLATE 4, figures 1–4. Buckfield, Maine. John A. Allen. No. 87304.

5. Woodland, Maine. O. Nylander. No. 58249.

6. Fairfield, Maine. J. H. Thompson. No. 58248.

7. Westbrook, Maine. A. D. Brown (Bolles). No. 4263.

8. Buckfield, Maine. John A. Allen. No. 87307.

9. Cotype of *P. floridana* Dall. Alachua Co., Fla. W. H. Dall. No. 58242.

10. Mt. Taylor, south of Volusia, Fla. H. A. Pilsbry. No. 72769.

11. San Marcos, Texas. H. A. Pilsbry. No. 90454.

12. Drift of Guadalupe River, 4 miles above New Braunfels, Texas. H. A. Pilsbry. No. 90456.

13, 16, 17, 21–27. Wetumpka, Alabama. H. H. Smith. Nos. 87151, 90458, 90425.

14, 15. Near Valley Head, Alabama. H. H. Smith. No. 90451.

18, 19. Woodville, Alabama. H. E. Sargent. No. 66901.

20. Big Wills Valley, 2 miles south of Valley Head, Alabama. H. H. Smith. No. 90453.

PLATE 5, figures 28, 29. Troy, New York. T. H. Aldrich. No. 58251.

30. Greenwich, New York. T. Bland. No. 3924.
31. Henry Co., Indiana. R. Walton. No. 58240.
32. Ocean City, New Jersey. H. A. Pilsbry. No. 72709.
33. Near Des Moines, Iowa. T. Van Hyning. No. 88439.
34, 35. Near New Philadelphia, Ohio. V. Sterki. No. 58239.
36. Cotype of *P. cincinnatiensis* Judge. Cincinnati, Ohio. Wm. Doherty. No. 58244.
37. Henry Co., Indiana. R. Walton. No. 58240.
38. Miami, Florida. S. N. Rhoads. No. 58253.
39. Des Moines, Iowa. T. Van Hyning. No. 79641.
40. Jasper Co., Missouri. M. A. Mitchell. No. 58254.
41. Silver Lake, Kansas. J. B. Quintard. No. 58246.

5. GASTROCOPTA TAPPANIANA (C. B. Adams). Pl. 3, fig. 9; pl. 5, figs. 42 to 53.

"Shell very small, pale horn-color, translucent, tapering above the penultimate whorl; whorls a little more than five, convex, with a well-impressed suture; aperture sub-orbicular (the penult. whorl cutting off about one-third of the circle), about one-third of the length of the shell; margin sharp, with a narrow contraction in the submargin, beneath which is a thickening within, on which are the labial teeth; teeth eight, five primary and three secondary; of the former the largest is on the penultimate whorl, the next largest on the left side of the aperture; at the base, beginning at the left hand, is a primary, then a secondary, a primary, a secondary, a primary and another secondary, extending nearly to the upper extremity of the right margin; the last three primaries are not constant in size; umbilicus open. Length 0.08 inch; breadth 0.05 inch.

"This species is easily distinguished from the preceding (*P. contracta*) by its teeth." (*C. B. Adams*, in Thompson's History of Vermont, 1842, p. 158.)

Ontario and Maine to Virginia and Alabama, west to South Dakota and Kansas, southwest to Arizona, but not known from the southeastern Atlantic States, Virginia to Florida. Type locality, Vermont.

Pupa tappaniana Ward, inedit, C. B. ADAMS, in Thompson's History of Vermont, 1842, p. 158. — *Pupa tappiana* Ward, PFEIFFER, Symbolae ad Hist. Heliceorum, ii, 1842, p.

55.—*Bifidaria tappaniana* (C. B. Ad.) PILSBRY and VANATTA, Nautilus, xix, 1906, p. 126, pl. 7, figs. 42–53.—WALKER, Occ. Pap. Mus. Zool. Univ. Mich., No. 15, 1915, pp. 7–11.—*Pupa pentodon f. curta* STERKI, Land and Fresh-Water Mollusca in the Vicinity of New Philadelphia, 1894, p. 5; Nautilus, xix, 1906, p. 134.

The shell is larger than *pentodon*, markedly conic though obtuse; only one tooth on the parietal wall, usually 6 on the columellar, basal and outer margins, those on the latter standing on a strong rib. Lower palatal tooth usually not so long and entering as in *B. pentodon*.

Length 2, diam. 1.2 mm.

Length 1.7, diam. 1.1 mm.

It is rather a common species in central Arizona, the westernmost locality being Jerome, Yavapai Co., a little west of the 112th meridian. Southward it has been found near the Mexican boundary in the Huachuca Mountains (Tanner canyon, 6000 ft.).

While it must be admitted that occasional individuals are intermediate between *tappaniana* and *pentodon*, yet the two forms are quite readily separable in the great majority of lots. They differ in station, *tappaniana* being found in low, moist places, under wood, often with *Vertigo ovata*, while *pentodon* lives in dryer situations, as Dr. Sterki has noted. *G. tappaniana* is not known from the southern Atlantic states, Virginia to Florida, but its range extends to the Gulf of Mexico in Alabama.

G. pentodon was long known as *Pupa curvidens*, and *G. tappaniana* as *P. pentodon*. In Binney's several publications the two are united under *P. pentodon*, the wood-cut representing *tappaniana*.

Form *curta* Sterki. "Examples from wet places are small and short ovoid." New Philadelphia, Ohio.

Fig. 9 of pl. 3 is from Falls of Schuylkill, West Philadelphia. The figures on plate 5 represent shells from the following localities:

Fig. 42. School Lane, Germantown, Philadelphia, Pa. R. Walton. No. 58250.

Fig. 43. West Fairmount Park, near Chamounix, Philadelphia, Pa. Vanatta. No. 58224.

Fig. 44. Buckfield, Maine. John A. Allen. No. 58219.

Fig. 45. Ithaca, New York. No. 62486.

Figs. 46–48. Upper Red Hook, Duchess Co., New York. W. S. Teator. No. 58218.

Figs. 49–52. Washington, D. C. E. Lehnert. A. N. S., No. 58225.

Fig. 53. Drift of Oak Creek, Page's Ranch, Oak Creek, Arizona. E. H. Ashmun. No. 82925.

6. GASTROCOPTA CARNEGIEI (Sterki). Pl. 10, fig. 5.

"Shell minute, ovate-conical with the apex nearly pointed, narrowly umbilicate and short-rimate, colorless whitish; whorls four to four and a half, well rounded with deep suture, the last large, rounded at the base; surface with very slight, irregular striæ, apex without striæ, microscopically rugulose; aperture rather large, well rounded, peristome sharp, not everted, with the ends somewhat approximate, palate with a very slight crest close to and parallel with the margin, inside with a very slight callous or none; lamellæ and folds: parietal rather large, nearly simple, columellar medium, an inferior columellar near the base, or wanting; the two principal palatals. Soft parts not examined. Alt. 1.2, diam. 1 mm.; other examples, 1.0 : 0.9" (*Sterki*).

Ohio: woods north of Geneva, Ashtabula Co. Type no. 1990, Sterki collection of N. A. Pupidæ.

Bifidaria minuta STERKI, Nautilus, xxix, January, 1916, p. 105. Not *Pupa minuta* "Say", Pfeiffer, 1842, also a *Bifidaria*.—*Bifidaria carnegiei* STERKI, Nautilus, xxx, November, 1916, p. 84.

"This *Bifidaria* is near *tappaniana* Adams, but differs from that species as follows: it is much smaller, more conical, the whorls are less in number, more rapidly increasing, more convex, the last is comparatively larger; there is no callous in the palate or a very slight one, the palatal folds are longer and there are no secondary ones (as supra- and interpalatal).

"It was a surprise to find a new *Bifidaria* in this part of the country, and it appears that the (three) specimens on hand represent a distinct species. If not closely examined,

they have the appearance of young or half grown of some other species, and probably were overlooked, partly due to the habit of most Bifidarias of this group of covering their shells with dirt'' (*Sterki*).

The type and only perfect specimen found is figured. It appears to be distinct from *pentodon* and *tappaniana*, but in so variable a group further specimens are required for a full understanding of its relation to known species.

7. GASTROCOPTA PILSBRYANA (Sterki). Pl. 3, figs. 10, 11, 12.

''Shell minute, narrowly perforate, cylindrical-oblong to cylindrical, somewhat attenuated towards the rather blunt apex; colorless (when fresh glassy), with a very delicate bluish tint; smooth and polished, with few, irregular, microscopic striæ which are more marked near the aperture. Whorls 4½ to 5½, moderately rounded with a rather deep suture, especially in the upper half, regularly and slowly increasing, the embryonal being relatively large, the last somewhat ascending toward the aperture; the latter of moderate size, lateral, subovate, margins approached; peristome somewhat expanded, without a thickened lip or a callous in the palatal wall; outside is a barely perceptible trace of a crest near the margin, and behind that a slight impression most marked upon the inferior palatal fold. Lamellæ 4 or 5: one apertural [parietal], rather high, of moderate length, simple; one columellar, horizontal, of moderate size, simple; basal very small or wanting; palatals the typical, inferior deeper-seated, of moderate size, superior small or very small. Alt. 1.5 to 1.7, diam. 0.8 to 0.9 mm.'' (*Sterki*).

New Mexico: Gallup, McKinley Co.; Sulphur Springs, near Jemez, Bernallilo Co. (*Ashmun*); Santa Fe (*Ashmun*), and Sandia Mts. (*Maud Ellis*), Santa Fe Co.; Las Vegas and Pecos, San Miguel Co. (*Cockerell*); Duran, Torrance Co. (*Pilsbry*); San Rafael (*Ashmun*) and Grant (*Pilsbry & Ferriss*), Valencia Co.; Black Range, Socorro and Sierra counties (*Pilsbry & Ferriss*); Sierra Blanca and Capitan Mts., Lincoln Co. (*Ashmun*); Cloudcroft, Sacramento Mts., Otero Co. (*Viereck*); Dripping Spring, Organ Mts., Dona

Ana Co. (*Cockerell*); Florida Mts., Luna Co. (*Pilsbry & Ferriss*); Big Hatchet Mts., Grant Co. (*Pilsbry*).

Arizona: Mt. Trumbull and Kaibab Plateau (*Ferriss & Daniels*), Grand Canyon, Bill Williams Mt. (*Pilsbry & Ferriss*), Flagstaff (*Ashmun*), Coconino Co.; Jerome, Yavapai Co.; Holbrook, Navajo Co.; Navajo Springs, Apache Co. (*Ashmun*); Blue River and Eagle Creek, Graham Co.; Santa Catalina Mts., Pima Co. (*Ferriss*); Chiricahua and Dragoon Mts. (*Pilsbry & Ferriss*), and Huachuca Mts. (*Ferriss*), Cochise Co.; Santa Rita Mts., 20 miles from Crittenden, Santa Cruz Co. (*Ashmun*). Type locality, Colorado River, Arizona.

Pupa pilsbryana Sterki, Nautilus, iii, March, 1890, p. 123. —*Bifidaria pilsbryana* Sterki, Pilsbry, Nautilus, xi, p. 118.—Pilsbry and Cockerell, Nautilus, xiv, pp. 85, 86.—Vanatta, Nautilus, xvi, p. 58.—Ashmun, Nautilus, xiii, p. 14.—Pilsbry and Ferriss, Proc. A. N. S. Phila., 1909, p. 415; 1910, p. 136.—Walker, Occ. Pap. Mus. Zool. Univ. Mich., No. 15, 1915, pp. 2, 3 (Canones Creek, east of Mt. Pedernal, and vicinity of Puerco Creek, Rio Arribo Co., N. M., *Case*).

G. pilsbryana is similar to slender examples of *G. pentodon* in shape and color, but it differs by having the lip thin, without any internal callous whatever, and there are never more than five teeth, but always five in adult shells. It has some resemblance to *G. pellucida*, but is retained in the section *Vertigopsis* because the parietal lamella is simple, an angular lamella being entirely wanting; but more because the basal fold is placed rather far to the left, a special character of *Vertigopsis*. The columellar lamella is a directly horizontal and rather short tubercle, not descending as in *pentodon*.

There is considerable variation in the size of the teeth, and also in the size of the shell, even in the same lots. The length varies from 1.65 to 1.9 mm.

This is one of the commonest species in the mountains or plateaus of over 4000 ft. elevation in both New Mexico and Arizona. Excepting the practically unexplored northern tier of counties in New Mexico, and the equally unknown two western counties of Arizona, it is known to occur in suitable places all over both states; but in the south these places are

well up in the mountains, where thousands of specimens can be obtained by sifting. The single record (Univ. of Colo. Studies, iv, p. 171) of *G. pilsbryana* from Colorado (Trinidad), was erroneous; the specimens are typical *G. pentodon.*

The record of this species from Chicorico canyon near Raton, N. M. (Nautilus, xiv, p. 83) was also an error for *G. pentodon.*

Subgenus IMMERSIDENS Pilsbry and Vanatta.

Immersidens PILS. & VAN., Proc. A. N. S. Phila., Dec. 11, 1900, p. 606 (for *B. ashmuni* and *B. perversa*).—PILSBRY & FERRISS, Proc. A. N. S. Phila., 1910, p. 136.

Gastrocoptas in which the angular lamella is united with the parietal at the inner end of the former, the two diverging forward, and together shaped like the Greek letter λ, or like a reversed *y*. The basal fold, when present, is radial, or transverse to the cavity. There are two palatal plicæ, *not standing on a callous ridge*, the lower one often deeply immersed. Peristome thin, expanded. Shell cylindric, thin, pale.

Type *G. ashmuni* (Sterki).

Distribution, central plateau and mountains from the Grand Canyon of the Colorado, northern Arizona, southward to southern Brazil and western Argentina.

The area of *Immersidens* in the United States has been rather well explored, so that few more species are to be expected. The occurrence of the group in central Mexico and Guatemala gives ground for the belief that forms will be found over much of the Mexican plateau. In South America true species of *Immersidens* occur as far south as Rio Grande do Sul (*G. iheringi*) and Argentina (*G. dicrodonta*), and it is likely that *G. pazi* (Hid.) also belongs to this section.

Most species of *Immersidens* daub the shell with dirt, like the species of *Albinula*, and unlike the cleaner typical Gastrocoptas.

Key to Species of Immersidens.

a. Inner end of the parietal lamella strongly curving towards the periphery; teeth large.

b. Sinistral; last whorl straightened and produced forward. *G. perversa*, no. 8.

b^1. Shell dextral.

c. Columellar lamella running forward on the parietal wall in the position of an infraparietal lamella; lower palatal and basal folds very deeply immersed; neck gibbous; peristome continuous.

d. Length about 2 mm. *G. ashmuni*, no. 9.

d^1. Length 1.6 to 1.8 mm.

G. ashmuni minor, no. 9*a*.

c^1. Columellar lamella normal in position, not running forward on the parietal wall, turned down at the inner end; peristome scarcely or not continuous; palatal plicæ visible in a front view; basal fold well developed.

d. A very strong, white crest behind the lip; columellar lamella having a long, vertical inner portion; length about 1.75 mm. *G. holzingeri*, no. 3.

d^1. No distinct crest on the neck; length, 2 mm. or more; Arizona.

G. cochisensis, no. 10.

a^1. Inner end of the parietal lamella curving outward very little; teeth not large; ends of peristome well separated; angular lamella low.

b. Columellar lamella very short; lower palatal plica rather deeply placed; basal fold minute, rarely wanting; Arizona. *G. oligobasodon*, no. 11.

b^1. Columellar lamella longer; lower palatal less deeply placed; no basal fold; central Mexico.

G. prototypus, no. 12.

b^2. Like *prototypus*, but with a well-developed basal fold; Guatemala. *G. p. basidentata*, no. 12*a*.

a^2. Inner end of the parietal lamella not distinctly curving towards the periphery; palatal and basal folds well developed, visible in a front view.

b. Entire columellar lamella horizontal; margins of peristome rather remote; Arizona.

c. Columellar lamella simple; parietal lamella

projecting very little forward of the junction of the angular. *G. dalliana*, no. 13.

c^1. Columellar lamella having a small callous below its inner end; parietal lamella projecting distinctly forward of the junction of the angular. *G. d. media*, no. 13*a*.

b^1. Columellar lamella horizontal in front, the inner end bent down at a right angle.

c. Peristome continuous; lower palatal and basal folds deeply placed; Arizona. *G. bilamellata*, no. 14.

c^1. Peristome interrupted above; lower palatal and basal folds not deeply placed; columellar lamella larger in a front view; Brazil. *G. iheringi*, no. 35.

a^3. Species not included in the key: *G. dicrodonta*, no. 34; *G. pazi*, no. 36.

8. GASTROCOPTA PERVERSA (Sterki). Pl. 6, figs. 9, 10, 11.

"Shell sinistrorse, oblong-cylindroconical, horn-colored, translucent; apex rather acute; base umbilicate-rimate, the umbilicus partly overlaid by a projecting part of the last whorl; whorls 5½, rather slowly and regularly increasing, convex, with the suture moderately deep, the last equaling two-fifths of altitude, slightly narrowed at the periphery, at last somewhat ascending and then protracted horizontally beyond the periphery of the spire, for a length equal to one-third of the diameter, with a rather high, oblique crest-swelling all around, in front of that contracted, and margins broadly everted all around at the aperture; on the palatal side of the protracted part, behind the aperture, a deep longitudinal (= spiral) impression; surface slightly shining, with fine, almost regular, crowded striæ; nucleus

FIG. 12.—*G. perversa*, basal view, most of the last whorl removed to show the angular, parietal and columellar lamellæ.

microscopically rugulose; aperture of moderate size, rounded below, truncated above, with a sinus occupying the upper half of the palatal side. Lamellæ and folds: angulo-parietal large; angular at its inner end joining the side of the parietal, with a curve reaching the margin at the supero-parietal angle; parietal very high, strongly curved, the (inner) convexity toward the columella, its front end at a rather large distance from the supero-columellar angle; columellar spiral, with its front end on the parietal wall, its inner part not visible; basal radial, lamellar, high; inferior palatal fold very deep in the throat, long, lamellar, curved downward over the basal, visible only from the outside; superior palatal fold quite short, high, tooth-like, in front of the inferior. Alt. 2.3, diam. of spire 1.1, whole diam. 1.5 mm.; apert. alt. 0.8, diam. 0.6 mm." (*Sterki*).

Arizona: Nogales (type locality; Ashmun); debris of Santa Cruz River, at Amado's ranch, above Tucson; Salt River debris, Tempe; debris of San Pedro River at Benson; Dragoon Mountains at several stations; Chiricahua Mountains in White Tail canyon and below Paradise (Pilsbry and Ferriss). Never at high elevations.

Bifidaria perversa Sterki, Nautilus, xii, Dec. 1898, p. 90.—Pilsbry and Ferriss, Proc. A. N. S. Phila., 1906, p. 144; 1910, p. 137, fig. 29.—Ashmun, Nautilus, xiii, p. 14 (Ephraim canyon, Santa Rita Mts.).

This species resembles *G. ashmuni* rather closely. The straightened part of the last whorl is somewhat longer, though the length of the free portion varies. There are also slight differences in the details of the teeth. Fresh specimens are very pale brown. As in *G. ashmuni*, the shell is extremely thin. It has been found only in Maricopa, Pima, Santa Cruz and Cochise counties, in southern Arizona. I have never found it so abundant as *G. ashmuni*.

9. Gastrocopta ashmuni (Sterki). Pl. 6, figs. 5, 6, 7.

Shell cylindro-conical, with the apex rather acute, base perforated-rimate; whorls five, convex, with a rather deep suture, regularly increasing, the last somewhat protracted,

with a crest remote from the aperture and forming a projecting angle at the base; at last ascending; aperture strongly lateral, rounded subtriangular, equaling one-third the altitude of the shell, highest near its columellar side, with a sinus above on the palatal side; margin continuous, strongly everted, broadest so below, without a lip thickening; parietal lamella very large, strongly curved, nearer the periphery at its inner end; angular lamella large, at its inner end united with the side of the parietal, at the outer with the palatal

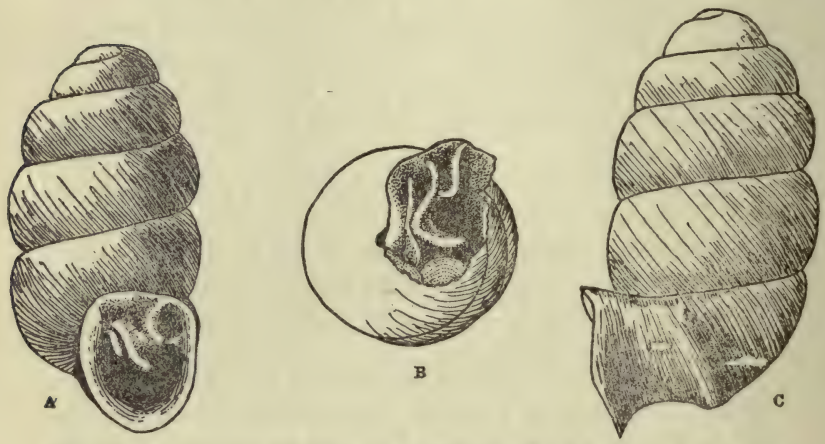


FIG. 13. Gastrocopta ashmuni. *a*, *b*, Florida Mts., N. M.; *c*, Oak Creek, Yavapai Co., Ariz.

margin, thus closing the sinulus above; columellar lamella large, spiral, ascending to the body whorl between the parietal and columella; basal lamella and inferior palatal fold deep in the throat, the former radial, the latter above it, oblique; superior palatal short, tooth-like, rather remote from the margin; surface shining, with slight, irregular striæ and microscopically rugulose, as is also the nucleus; shell horn-colored, transparent; lamellæ and folds whitish. Alt. 2, diam. 1.1 mm. (*Sterki*).

From Valencia Co., New Mexico, and the southern rim of the Grand Canyon, Arizona, south to the Mexican boundary from Nogales, Arizona, to the Big Hachet Mountains, New

Mexico; and from the Organ Mountains and Whiteoaks, Lincoln Co., N. M., on the east, to the vicinity of Jerome, Yavapai Co., Arizona, on the west. Chiefly in broken country and foothills, but up to about 8000 ft. in some places.

Bifidaria ashmuni Sterki, Nautilus, xii, Sept. 1898, p. 49 (Santa Rita Mts., Arizona, Ashmun; Cook's Peak and Dripping Spring, Organ Mts., N. M., Cockerell).—Ashmun, Nautilus, xiii, p. 14 (Santa Rita Mts., 20 miles from Crittenden).—Pilsbry and Ferriss, Proc. A. N. S. Phila., 1906, p. 144; 1910, pp. 137–139, f. 30.—*Bifidaria ashmuni* form *minor* Sterki, Nautilus, xii, Dec. 1898, p. 92 (Nogales, Arizona).—Pilsbry and Ferriss, Proc. A. N. S. Phila., 1910, p. 139, f. 31.—Ashmun, Nautilus, xiii, p. 14.

This species is readily known by the strong development of the angulo-parietal lamella, the very deep immersion of the lower palatal and basal folds, the anterior continuation of the columellar lamella upon the parietal wall, alongside the parietal lamella, and the long, gibbous neck of the last whorl.

It is a common species within the limits given above, the territory being well covered by over fifty lots in the museum of the Academy, collected chiefly by Ashmun, Ferriss and the writer.

The typical form of *G. ashmuni* is nearly cylindric, tapering but slightly, composed of five strongly convex whorls. The last whorl becomes straightened and slightly sinuous in basal view, and has a more or less conspicuous oblique swelling or crest some distance behind the aperture. This crest is not always so strong, as shown in fig. 13 *c* (a specimen from Page's Ranch, Oak Creek, in central Arizona), and sometimes it varies from strong to wanting in the same lot. The peristome is well expanded, continuous, and usually stands shortly free from the whorl in front. The parietal lamella is sigmoid, bending far to the right at its inner end. The angular lamella, also sigmoid, runs from the peristome to the parietal lamella, the two lamellæ together forming a figure like the letter λ. The columellar lamella is broad and horizontal far within, arising a half-whorl back (pl. 6, fig. 7), then sinuated where the basal plica approaches it, as shown in pl. 6, fig. 6,

but near the aperture *it runs out upon the parietal wall*, where it appears as a more or less elevated cord between the parietal lamella and the columella, occupying, therefore, the place of an infraparietal lamella. These lamellæ are well shown in fig. 13 *b*, a basal view in which the base of the shell has been removed. The upper palatal fold is short, situated some distance within the mouth, but visible from in front. The lower palatal is long, entering, and so deeply immersed that it is not visible in a front view, being concealed behind the massive parietal barrier. There is a radially-placed basal fold, scarcely or not visible in a front view; the edge is seen in pl. 6, fig. 6. Length about 2, diam. 1 mm.

9*a*. Form *minor* Sterki. "Smaller than the types, 1.5 to 1.9 mm. high; the shell is also thinner, the color paler, the

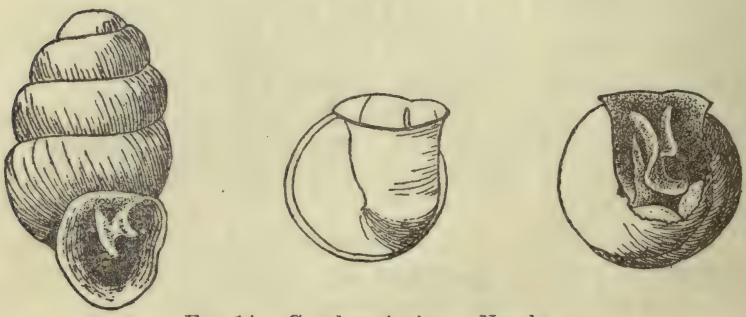


FIG. 14. *G. ashmuni minor*. Nogales.

everted part of the lip less broad, the number of whorls one-half to one less" (*Sterki*). Length about 1.6 mm., with 4 to 4½ whorls. The structure is otherwise substantially as in *ashmuni*.

Arizona: Nogales; also on the Mexican side of the international boundary, and Ephraim canyon, Santa Rita Mts. (E. H. Ashmun). Dragoon Mountains, in colonies with the typical form (Pilsbry, Ferriss and Daniels).

10. GASTROCOPTA COCHISENSIS (Pilsbry and Ferriss). Pl. 6, figs. 1 to 4, 8.

The shell is rimate, slightly tapering-cylindric, thin, pale

brown, composed of 5½ strongly convex whorls, the last third of a whorl straightened. Striation faint. The aperture is squarish with rounded angles. Peristome rather broadly expanded, thin, brownish, interrupted on the parietal margin, or continuous by a fine thread. Parietal lamella high, its inner end distinctly curving towards the periphery. Angular lamella about half as high as the parietal, slightly sigmoid. Columellar lamella strong, short, its inner half descending somewhat. Palatal plicæ all visible in a front view. The upper one is rather high and short, not far within; lower one deeply immersed, partly concealed behind the parietal in a front view; basal plica radial (transverse to the cavity), deeply immersed.

Length 2.2, diam. 1.1 mm.
Length 2.5, diam. 1.1 mm. } Cotypes.
Length 2.15, diam. 1.1 mm. Santa Rita Mts.

FIG. 15. *G. cochisensis.* Santa Rita Mts., Arizona.

Arizona: Chiricahua Mountains, on the summit of Cross J Mt., Big Emigrant canyon, about 8000 ft.; White Tail canyon; Limestone Mountain (Pilsbry and Ferriss). Huachuca

Mts., in Tanner canyon (Ferriss). Santa Rita Mountains (E. H. Ashmun). Drift of the Santa Cruz River, Pima Co. (Pilsbry). Santa Catalina Mts. at Alder Springs and Marble Peak (Ferriss).

Bifidaria cochisensis PILSBRY and FERRISS, Proc. A. N. S. Phila., 1910, p. 139, figs. 32, 33.

This species differs from *G. ashmuni* in the following features: All the teeth are smaller. The columellar lamella is very much shorter, and does not continue forward upon the parietal wall. The palatal plicæ are less deeply immersed, all being visible in a front view in the aperture. The parietal and angular lamellæ are much less curved. The last whorl is less protracted, never free in front, with a lower crest or wave on the neck, or none.

It is far less widely distributed than *G. ashmuni*, and even in its area is of less general occurrence, all of the known localities being given above.

11. GASTROCOPTA OLIGOBASODON (Pilsbry & Ferriss). Pl. 7, figs. 8, 9, 10, 11.

The shell resembles *G. cochisensis*, from which it differs in the following details: All of the teeth are smaller. The parietal and angular lamellæ are far less curved, and the angular joins the parietal near the outer end of the latter. The columellar lamella is much shorter (pl. 7, fig. 8). The basal plica is reduced to a minute tubercle, or in some individuals it seems to be wanting. The parietal margin of the peristome is adnate for a greater distance.

Length 2.6, diam. 1.1 mm.

Length 2.1, diam. 1 mm.

Arizona: Ash canyon, Huachuca Mts., type loc. (Ferriss); Lower Rucker canyon, Chiricahua Mts. (Ferriss). New Mexico: drift debris of the Mimbres River at Swartz P. O. and near Deming (Pilsbry & Ferriss); debris of Rio Grande at Mesilla (Cockerell).

Bifidaria cochisensis oligobasodon PILS. & FERR., Proc. A. N. S. Phila., 1910, p. 141, figs. 34*a-c*.

This shell was formerly considered a subspecies of *G. cochi-*

sensis, but having carefully gone over larger series of both than I had seen in 1910, I fail to find any really connecting examples. It stands nearer *G. prototypus*, but differs in the shape of the columellar lamella, which is placed somewhat obliquely, and descends inward as a whole, while in *prototypus* the whole lamella is horizontal but with a thickening

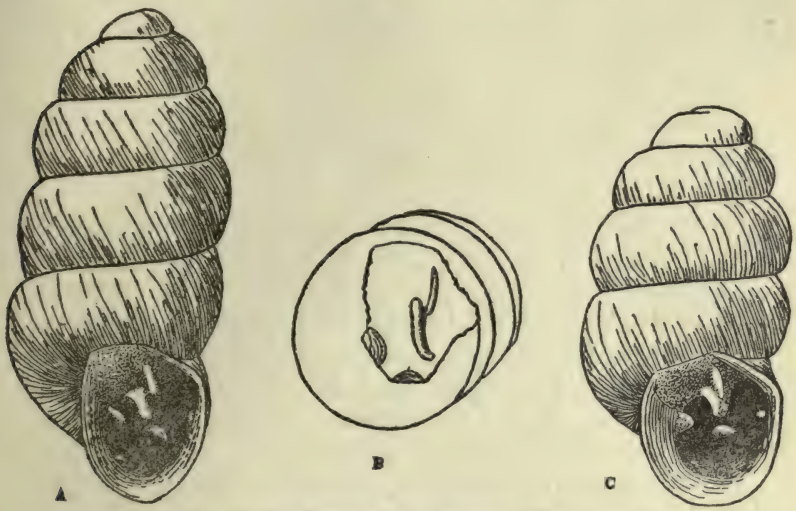


FIG. 16. *G. oligobasodon.* Ash canyon, Huachuca Mts.

below its inner end, and another running upwards. The lower palatal plica is far more deeply placed in *oligobasodon* than in *prototypus*. In a large series of *prototypus* examined, none has a basal plica. In *oligobasodon* this fold is rarely absent.

12. GASTROCOPTA PROTOTYPUS (Pilsbry). Pl. 7, figs. 1 to 5.

The shell is shortly rimate, subcylindric, slightly tapering upwards, light brown, lightly striate, with but little gloss; composed of 5⅓ strongly convex whorls, the last without any trace of a wave or crest behind the lip or on the neck. The aperture is squarish-oval; peristome thin, well expanded except near the upper end of the outer lip; insertions separated by nearly half the width of the mouth. Both angular

and parietal lamellæ are nearly straight, diverging in front of their union, which is marked by a notch. The inner end of the parietal lamella bends a little towards the periphery. Columellar lamella horizontal, the inner end having a small white callous below, not visible from in front. There is also a callous running up the columellar axis, but it is nearly colorless (pl. 7, figs. 2, 4). The upper palatal plica is minute, tubercular; the lower is larger, and a little more deeply placed. No basal fold.

Length 2.55, diam. 1.1 mm.

Mexico: Huingo, in the State of Michoacan (type loc.; S. N. Rhoads); Guadalajara, State of Jalisco (McConnell and Crawford).

Bifidaria prototypus Pils., Proc. A. N. S. Phila., 1899, p. 400; 1903, p. 766, pl. 50, f. 7, 7*a*; 1910, p. 142, f. 35.

This species stands nearest *G. oligobasodon*, but differs by the less deeply immersed lower palatal plica, the absence of a basal plica, and the shape of the inner end of the longer columellar lamella (compare pl. 7, figs. 2 and 8). The parietal lamella extends a little further forward of the junction of the angular lamella than in *oligobasodon*.

The specimens from Guadalajara vary in size: length 2.45, diam. 1.1 mm., to length 2.2, diam. 1.03 mm.

It may be regarded as a connecting link between typical *Gastrocopta* and *Immersidens*.

12*a*. *G. prototypus basidentata* n. subsp. Pl. 7, figs. 6, 7.

These shells agree in form and size with *prototypus*, but differ by having a well-developed basal fold. The columellar lamella is strong and horizontal, not short as in *B. oligobasodon*. The inner end of the angular lamella unites with the parietal lamella (fig. 7), as in *prototypus*. The outer lip is thin, with no crest back of it. The figured shell measures, length 2.35, diam. above aperture 1.05 mm.

Locality, Guatemala City (type no. 190017 U. S. Nat. Mus., from Sr. Gomez).

This form needs to be compared with *G. pazi* (Hidalgo) when authentic specimens of that species become available.

13. GASTROCOPTA DALLIANA (Sterki). Pl. 8, figs. 5 to 9.

"Shell minute, ovate-turriculate, perforate-rimate, pale horn-colored, translucent; apex somewhat obtuse; whorls 5, regularly increasing, convex, with the suture deeper between the upper than the lower whorls; the last whorl ascending at the aperture, compressed at the periphery, especially so toward the aperture, with a slight, shallow crest-elevation, its base narrow except just behind the aperture, where there is a slight depression; surface with very fine, crowded striæ; aperture equaling a little over one-third of altitude, almost as wide as high, rounded below, with three almost equal angles above, margins approximate, somewhat extended upward and connected by a slight, straight callous, somewhat everted, especially below, without a thickened lip. Lamellæ and folds: angular and parietal rather large, connected but distinct, the former ending at the margin; a nodule-like infraparietal; columellar rather large, lamellar, horizontally encircling the somewhat projecting columella; basal transverse (radial) on the impressed part of the base, short lamellar, abrupt; parietal folds approximate, the superior rather short, the inferior longer, deeper in the throat, somewhat oblique. Alt. 1.6 to 1.8, diam. 0.8 to 0.9, apert. alt. 0.6 mm." (*Sterki*).

Southeastern Arizona: Nogales (type locality) and Santa Rita Mts., Santa Cruz Co. (Ashmun); mouth of Sabino canyon, Santa Catalina Mts., Pima Co. (Ferriss); Eagle Creek, Graham Co. (Ferriss); Dragoon and Chiricahua Mts., Cochise Co. (Pilsbry and Ferriss).

Bifidaria dalliana STERKI, Nautilus, xii, Dec. 1898, p. 91.—PILSBRY and VANATTA, Proc. A. N. S. Phila., 1900, p. 593, pl. 22, f. 8.—PILSBRY and FERRISS, Proc. A. N. S. Phila., 1910, p. 143, f. 36*a*.—ASHMUN, Nautilus, xiii, p. 14 (Ephraim canyon, Santa Rita Mts.).

The shell is generally smaller than *G. hordeacella*, the angulo-parietal lamella is conspicuously complex, and the basal plica is transverse instead of entering. It is related to *G. bilamellata*, from which it differs by the more cylindric shape, the less diverging outer ends of the parietal and angular lamellæ, and the simple columellar lamella. The ends of the

lip are rather widely separated in *dalliana*, connected in *bilamellata*.

The shell is very fragile and usually dirty, like all the species of the same section. The inner end of the angular lamella lies adjacent to the outer end of the parietal, with a lower connecting callous between them. The parietal may project slightly forward of the junction, or it may stop there. Its inner end usually bends a trifle outward. The columellar lamella is stout and transverse (pl. 8, fig. 8). Fig. 17 is from a paratype. Length 1.8, diam. 0.8 mm.

In the Chiricahua and Dragoon mountains it is often larger than the types, up to 2 mm. long, .85 wide. The basal fold is usually longer than in the typical form.

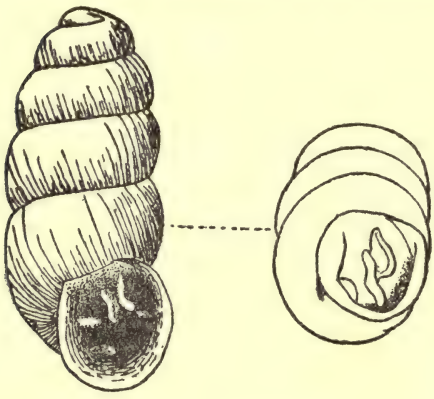


FIG. 17. *G. dalliana.*

FIG. 18. *G. bilamellata.*

13*a*. *G. dalliana media* n. subsp. Pl. 8, figs. 10, 11.

The shell is like *dalliana* in size, shape and fragility. It differs by having a callous buttress below the inner end of the columellar lamella (pl. 8, fig. 11). This is much less developed than that of *G. bilamellata*. The parietal and angular lamellæ are less intimately united, and the former reaches further forward (pl. 8, fig. 10). The terminations of the lip are rather widely separated, as in *dalliana*.

Distribution. — Arizona: Montezuma's Well, several miles

north of the S. P. Railroad close to where it enters Maricopa Co. from the east, type loc.; 5 miles south of Jerome, Yavapai Co. (Ashmun).

The localities of *media* are west of all those known for *G. dalliana*, but its range seems to be overlapped by the eastern extension of *bilamellata*. Its structural characters are between the two.

14. Gastrocopta bilamellata (Sterki and Clapp). Pl. 8, figs. 1 to 4.

"Shell small, slender, cylindrical or slightly attenuated above, with an obtuse apex, perforate; whorls 5½, subequal, the apical ones comparatively large; colorless to pale or reddish-horn (so far as can be seen from drift specimens), transparent; surface shining, with very fine, crowded, subregular striæ, on the apex microscopically rugulose; the last whorl ascending above, somewhat flattened at the base close to the aperture, keel-like further back, somewhat flattened over the palate, with a slight to strong, not sharp, crest behind the margin, with two spiral impressions, one over the lower palatal and another near the base; aperture broadly elliptical to almost circular, peristome continuous or its ends closely approximate and connected by a raised callous, well everted, with a slight to rather strong lip thickening; lamellæ and plicæ, parietal and angular, well differentiated, connected, large, the angular connecting with the peristome; columellar complex, with a lower axial and an upper horizontal part; 'basal' a short, transverse lamella, rather abrupt; lower palatal far remote from the margin, but visible in front view, rather long, lamellar, thin; upper palatal somewhat less deep-seated, close to the lower, somewhat oblique, shorter.

"Alt. 2–2.4, average 2.2, diam. 0.9 mm.; aperture alt. 0.8 mm. Soft parts not seen" (*Sterki*).

Arizona: foothills of Plumosa Range, about 8 miles east of Quartzsite, Yuma Co., in drift (type loc.; G. S. Hutson); Salt River drift, Tempe, Maricopa Co. (Pilsbry and Ferriss).

Bifidaria bilamellata Sterki and Clapp, Nautilus, xxii,

March, 1909, pl. 8, f. 7.—Sterki, Nautilus, xxii, April, 1909, p. 126.—Pilsbry and Ferriss, Proc. A. N. S. Phila., 1910, p. 143, f. 36 *b*.

This species, which replaces *G. dalliana* in western Arizona, differs from that by the longer, more tapering shell, the nearly or quite continuous peristome and the shape of the columellar lamella, which has a vertical portion running down from its inner end, longer than in *G. d. media*. The parietal lamella runs forward further than in *G. dalliana*. In the type locality it was found in company with *G. hordeacella* and *C. intuscostata*, in the ratio of about 1 *bilamellata* to 16 *hordeacella* (text fig. 18).

The specimens from Tempe are typical in all respects, and occurred with the same and other species in the drift debris. The largest and smallest measure:

Length 2.35, diam. .83 mm.

Length 1.95, diam. .8 mm.

Subgenus Privatula Sterki.

Privatula Sterki, Nautilus, vi, p. 101, 1893, monotype *P. corticaria* Say.

The shell is whitish, without palatal callous or folds, the columellar lamella minute, tubercular, angulo-parietal lamella small and straight, its crest bilobed.

The teeth are reduced more than in any other Gastrocopta. Only one species is known. It is probably related to *Albinula* and *Sinalbinula*, from which it differs by the absence of palatal callous and plicæ.

15. Gastrocopta corticaria (Say). Pl. 10, figs. 1 to 4.

The shell is minutely rimate, nearly cylindric, tapering slightly to the very obtuse summit; thin, translucent-white, almost smooth, very faintly marked with growth-lines. Whorls 5½, quite convex, the last rounded basally, without a crest behind the lip. Aperture irregularly oval; peristome thin, well expanded, the lip-ends widely separated. Angular and parietal lamellæ united into one small bilobed lamellæ, or almost separate. Columellar lamella very low, subvertical, a minute tubercle in front of its lower end.

Length 2.5, diam. 1 mm.

Maine and Ontario to Minnesota, south to St. Simon's Island, Georgia, northern Alabama and Alexandria, Louisiana. Type locality, Philadelphia, Pa.

Odostomia corticaria Say, Nicholson's American Encyclopedia, ii, pl. 4, fig. 5, 1816.—*Pupa corticaria* Say Pfeiffer, Monogr. Hel. Viv., ii, 228; vi, 304.—Binney, Terr. Moll., ii, p. 339, pl. 72, f. 4.—W. G. Binney, Terr. Moll., v, 1878, p. 209, f. 113, 114, pl. 72, f. 4.—*Leucochila corticaria* Say, Morse, Terr. Pulm. Maine, p. 36, f. 87, pl. 10, f. 88.

G. corticaria has the teeth more reduced than in any other *Gastrocopta*. The angular lamella is variable, sometimes rather well developed, as in figures 1, 4, sometimes minute, and scarcely united with the parietal lamella, and in some apparently mature shells it is entirely wanting. The very low columellar lamella runs vertically on the back of the rather large axis, and either turns outward in a short horizontal limb at the lower end, or a very low tubercle, visible from in front, stands in front of its lower end (pl. 10, fig. 3).

As the name denotes, *G. corticaria* is often found crawling upon trees a foot or two from the ground. While generally distributed, it rarely occurs in abundance, and is not known from the higher Catskills, southern Alleghanies, or other elevated regions. So far as I have seen specimens, its western limit is in Minnesota, Iowa and Arkansas. No local or geographic races have been noticed.

Subgenus Gastrocopta Wollaston.

Gastrocopta Wollaston, Test. Atlant., 1878, p. 515.—*Bifidaria* Sterki in Pilsbry, Proc. A. N. S. Phila., 1891, p. 315.—*Eubifidaria* Sterki, Nautilus, vi, p. 101, 1893, type "*P. hordeacea* Gabb" of Sterki, = *G. cristata* (Pils. & Van.).

The shell is rimate, cylindric or oblong-conic, having the angular and parietal lamellæ concrescent into a sinuous or bifid lamella; columellar lamella horizontal, short. Palatal folds not standing upon a callous ridge, the upper and basal sometimes wanting, the basal, when present, in the base of the aperture, not subcolumellar in position.

Type *G. acarus* (Bens.).

Distribution, tropical and warm temperate portions of America and Africa; Mascarene Is., Ceylon, the Philippines and Hawaiian Islands.

This group is developed in warm temperate and tropical America, chiefly from the southern tier of states in the United States to the Argentine Republic. They are the common and abundant Pupæ of much of these regions. Besides its distribution in North and South America (species nos. 16 to 32), where the greatest number and variety of species have been found, typical Gastrocoptas inhabit Africa and the islands in the Indian Ocean (species nos. 66 to 76), Ceylon and perhaps India (species 77, 78), the Philippines and Oahu (species nos. 86, 87).

Gastrocopta appears to be related to *Immersidens*, but not closely to the northern group of subgenera, *Albinula, Sinalbinula*, etc. Among other significant differences, the position of the basal plica may be noted. In *Albinula, Sinalbinula* and *Vertigopsis* this plica is more or less obviously *subcolumellar* in position; so much so that many describers have referred to it as a second or inferior columellar tooth. In *Gastrocopta* and *Immersidens* it never assumes a subcolumellar position.

The species are much alike and partly difficult to distinguish, both from the absence of salient differential characters, and in some cases from the resemblance of simplified members of different specific stocks. They are especially variable in the development and prominence of callosities or tubercular teeth below and above the columellar lamella, and the prominence of the crest behind the outer lip, and are somewhat variable in the degree of concrescence of the angular and parietal lamellæ. Moreover, a number of the species have been so imperfectly defined that positive decisions are at present unattainable.

Key to North American and Antillean Species.

a. Lip distinctly or heavily calloused within.

b. Form distinctly tapering; callous of the lip heavy.

c. Corneous or whitish, the lip white.

G. rupicola, no. 17.

c^1. Cinnamon-colored, the lip tinted.

d. Subcolumellar nodule present.

G. r. duplex, no. 17*b*.

d^1. No subcolumellar nodule or callous.

G. r. marginalba, no. 17*c*.

b^1. Form cylindric.

c. Parietal lamella strongly bifid in a front view.

d. Small, length 2 to 2.45, diam. 1 mm. or less.

e. Lower palatal plica not very deeply immersed; Antilles. *G. barbadensis* and var., nos. 24, 24*a*.

e^1. Lower palatal plica deeply immersed; Dakota to New Mexico. *G. p. mcclungi*, no. 18*c*.

d^1. Larger, length 2.25 to 3, diam. 1 mm. or more.

e. Anterior end of parietal lamella not conspicuous.

f. Lip heavily calloused.

g. A callous below columellar lamella.

G. procera, no. 18.

g^1. No callous below columellar lamella.

G. p. riparia, no. 18*a*.

f^1. Lip callous thin; an infraparietal often developed.

G. riograndensis, no. 20.

e^1. Anterior end of parietal lamella distinctly projecting.

f. Lip-callous marginal.

G. p. mcclungi, no. 18*c*.

f^1. Lip-callous further within.

G. p. duplicata, no. 18*b*.

c^1. Parietal lamella simpler, sinuous.

d. Larger, strongly crested, 2.3 to 3.2 mm. long, more than 1 mm. wide; Oklahoma to Arizona. *G. cristata*, no. 19.

d^1. Smaller, 2 to 2.2 mm. long, 0.9 mm. wide; Bimini Islands.
G. p. biminiensis, no. 22*a*.

a^1. Lip thin, not calloused within.
b. Having 5 well-developed teeth, a basal fold present.
c. Diam. usually over 1 mm., about 2.5 mm. long; brownish.
d. No crest behind the lip; parietal tooth not strongly bifid, no infraparietal tubercle. *G. servilis*, no. 21.
d^1. A narrow crest; parietal bifid; an infraparietal nodule often developed.
G. riograndensis, no. 20.
c^1. Diam. 1 mm. or less; length 1.5 to 2.6 mm.
d. Parietal strongly bifid; a callous or tooth below the columellar lamella.
e. An infraparietal nodule present.
G. polyptyx, no. 25.
e^1. No infraparietal tooth.
G. barbadensis, no. 24.
d^1. Parietal sinuous or emarginate, but not distinctly bifid.
e. Diam. one-third the length; Curacao. *G. longurio*, no. 23.
e^1. Somewhat wider.
G. pellucida and varr., no. 22.
d^2. Parietal simple and straight, angular wanting or minute.
e. Ovate-conic, 1.2 x 1 mm.; peristome not expanded; Ohio.
G. carnegiei, no. 6.
e^1. Cylindric, 1.7 x 0.9 mm.; peristome expanded; Arizona, New Mexico. *G. pilsbryana*, no. 7.
c^2. Having 4 strongly-developed teeth, the angulo-parietal almost simple; no basal fold; shell albino; New Mexico and Arizona.
G. quadridens, no. 16.

c^3. Teeth small, the basal fold usually wanting, upper palatal plica minute when present.

d. Length 2.2 to 2.4, diam. 0.95 mm.; St. Thomas. *G. riisei*, no. 21*a*.

d^1. Slightly narrower, with deeper suture; Arizona. *G. p. parvidens*, no. 22*d*.

d^2. Length 1.36 to 1.55 mm., 4 to 4½ whorls; very thin and fragile; Bimini Islands. *G. p. delicata*, no. 22*b*.

16. GASTROCOPTA QUADRIDENS Pilsbry, n. n. Pl. 10, figs. 7, 10.

"Shell narrowly perforate-rimate, conical-turriculate, with the apex somewhat obtuse; colorless, glassy; surface very slightly striated, shining; whorls 6, gradually increasing, with the suture rather deep between the upper, less so between the lower whorls; the last whorl moderately ascending at the aperture, rather rounded at the base, slightly expanded near the aperture, with an impression over the inferior palatal fold; aperture rather oval, truncated above, margins well everted, the palatal somewhat more curved than the columellar, the two connected by a thin callous; lamellæ and folds four, subequal; angulo-parietal appearing almost simple, inclined toward the columella; columellar horizontal, rather short and strong, palatals rather short and stout, in normal position, the inferior somewhat larger and more remote from the margin. Alt. 2.4 to 2.8, diam. 1.3; apert. alt. 1.0 mm." (*Sterki*).

New Mexico: Capitan Mts., Lincoln Co. (type loc.; E. H. Ashmun); Black Range, Sierra and Grant Cos. (Ferriss and Pilsbry). Arizona: Bill Williams Mt., Coconino Co. (Pilsbry and Ferriss); Mt. Mingus, near Jerome, Yavapai Co. (Ashmun); Santa Catalina and Chiricahua Mts. (Ferriss).

Bifidaria quadridentata STERKI, Nautilus, xii, March, 1899, p. 125. Not *Pupa quadridentata* Klein, 1853, also a *Gastrocopta*. — *Bifidaria quadridens* Sterki, PILSBRY and VANATTA, Proc. A. N. S. Phila., 1900, p. 607 (*lapsus calami*).

This is a strikingly distinct species. By the very thin, translucent, paraffine-white shell, without a crest behind the

thin lip, it recalls *G. corticaria*, which is perhaps the species most nearly related. The angulo-parietal lamella is simple, as in *pentodon* or *pilsbryana*, or sometimes the extremely minute trace of the forward end of the parietal lamella appearing as a branch on the columellar side, may be seen near the outer end. The lower or free edge of the parietal lamella is bent towards the columella as in *G. cristata*. The lower palatal fold is usually rather long. The columellar lamella is transverse, as in the *procera* group, and there is no callous below it. In a great number I have seen, none has a basal plica.

It is a common shell in the heavily-forested and humid upper zone of the Santa Catalina Mountains, north of Tucson, and in the Black Range, New Mexico, but very rare in the Chiricahua Range, at the southern limit of the species, where it occurred in Barfoot Park, 10,000 ft. elevation. Its stations are chiefly between 7,000 and 11,000 ft., and never at low levels.

As the name *quadridentata* is in use for a species of *Gastrocopta* from the German Upper Miocene, I am substituting *quadridens*, which although used for the species in 1900 quite inadvertently, and with no intention to form a new name, may serve now that the original name is not admissible.

I have a strong suspicion that this species, like *G. corticaria*, belongs to the same stock as *Sinalbinula* and *Vertigopsis*, and should form another subgenus; yet for the present it is left with the *rupicola* group, which it resembles in general features.

17. GASTROCOPTA RUPICOLA (Say). Pl. 11, figs. 1, 2, 3, 5, 6.

"Shell dextral, attenuated to an obtuse apex, white; whorls six, glabrous; suture deeply impressed; labium bidentate; superior tooth lamiform, emarginate in the middle, and at the anterior lip obsoletely uniting with the superior termination of the labium; inferior tooth placed upon the columella, and extending nearly at a right angle with the preceding; labrum tridentate, teeth placed somewhat alternately with those of the labium, inferior tooth situated at the base and immediately beneath the inferior tooth of the labium. Length, one-tenth inch" (*Say*).

Length 2.5 to 2.2 mm.

South Carolina to the keys of south Florida, west along the Gulf coastal plain to Galveston, Texas. Bermuda. North Cat Cay, Bimini group, Bahamas. Type locality, ruins of Fort Picolato, St. John's River, Florida.

Pupa rupicola SAY, Journ. Acad. Nat. Sci. Phila., ii, 1821, p. 163.—GOULD, Boston Journal of Natural History, iv, 1843, p. 355, pl. 16, f. 13.—BINNEY, Terr. Moll., iii, pl. 70, fig. 1 (left and central figs.).—STERKI, Nautilus, iv, 1891, p. 139.—*Bifidaria rupicola* (Say), PILSBRY and VANATTA, Proc. A. N. S. Phila., 1900, p. 595, pl. 22, f. 1.

This species *tapers upwards* much more than *G. procera*, which is subcylindric. *G. servilis* has a thinner lip. In *G. rupicola* the outer and basal margins of the peristome are spreading, broad, and *conspicuously thickened by a heavy white callous* within the sharp edge. This callous is narrowed near the posterior angle as usual. The angulo-parietal lamella shows a small lateral spur in the front view. Seen from below (pl. 11, fig. 6) it is very slightly sinuous, nearly straight except in front, where it curves outward to unite with the outer lip. The columellar lamella consists of a very low, vertical portion which bends forward below, forming a strong horizontal portion (fig. 5). The lower palatal plica is not much lengthened, but is larger and more deeply placed than the upper. There is a narrow and low but distinct crest close behind the lip, and a flattening over the position of the lower palatal plica. Length 2.5, diam. 1.1 mm.; 5¾ whorls. The color varies from very pale brown to corneous, the surface being very finely, rather irregularly striate.

In some places the average size is smaller, as at Miami, Florida. In other colonies, as at Lossman's Key, in the Ten Thousand Islands (pl. 11, fig. 1; length 2.2 mm., 5 whorls) both the maximum and the minimum sizes were found living together, the smallest 2.1 mm. long. There is a more or less developed callous buttress under the inner end of the parietal lamella in this and some other lots, while in typical *rupicola* it is absent or only weakly developed.

Pl. 11, fig. 3, is abnormal in having the lower palatal plica doubled, but such abnormalities are not uncommon.

The continental *rupicola* is an albinistic race, the insular *marginalba* being more normal for the group in color.

Before 1890, this species was thought to include *G. procera* Gld., and the name was so used in the writings of W. G. Binney and others. Gould, and afterwards Sterki, pointed out the differential characters.

17*a*. *G. rupicola matacumbensis* n. subsp. Pl. 14, figs. 1, 2, 3.

The shell is fragile, milk-white, without a crest behind the reflected lip; the latter being only slightly or moderately thickened, very much less than in typical *rupicola*. There is a callous below the inner end of the columellar lamella. All of the teeth are somewhat smaller than in *rupicola*.

Length 2.5, diam. 1.1 mm. (type).

Length 2.35, diam. 1.1 mm.

Length 1.85, diam. 0.93 mm.

Lower Matacumbe Key, Florida, near the water-tank (Geo. H. Clapp).

Some dwarf specimens from the same place are less than 2 mm. long, with the aperture relatively larger (pl. 14, fig. 3). It was taken in abundance by Mr. Clapp. The lip is thicker than in *G. servilis*, which has not been found in Florida.

17*b*. *G. rupicola duplex* n. subsp. Pl. 11, figs. 4, 7, 9.

The shell is similar in shape and size to the typical form, but cinnamon-colored, having the lip white and not greatly thickened. The columellar lamella is heavily calloused above and below, the lower callous more or less distinctly tuberculiform (fig. 7).

Bermuda: Bailey's Bay and other localities. Type and paratypes no. 105797 A. N. S. P., from above Whitby Cave.

17*c*. *G. rupicola marginalba* (Pfeiffer). Pl. 11, figs. 10 to 13; pl. 10, figs. 6, 8, 9.

The shell is cinnamon-colored, form convexly-tapering; a crest (sometimes weak) behind the lip. Lip-callous heavy, also cinnamon-colored. Angulo-parietal lamella more distinctly bifid in front view than that of typical *rupicola;* and typically the front end of the parietal lamella projects more

or less on the columellar side (pl. 10, figs. 8, 9). The columellar lamella is simple, short and horizontal, its inner end having only a very low, hardly perceptible buttress below. The lower palatal plica is a little longer than in *rupicola*. The surface is rather distinctly striate.

Length 2.45, diam. above aperture 1.23 mm. Matanzas, fig. 13.

Length 2.5, diam. above aperture 1.1 mm. Matanzas, fig. 12.

Cuba: hillside west of Matanzas and on the west side of Matanzas Bay (Pilsbry); Loma de Capiro, Santa Clara; San Vicente de los Baños (J. B. Henderson); San Jose (Ch. Wright in U. S. N. M.). Jamaica (Gloyne in A. N. S. P.). Bermuda: Church Cave, near Tuckerstown, etc. (Vanatta, S. Brown and others).

Pupa marginalba Pfr., Wiegmann's Archiv. für Naturgeschichte, 1840, i, p. 253; Monographia Hel. Viv., ii, 1848, 356; iii, 555; iv, 680; vi, 327. — Küster, Syst. Conchylien Cabinet, p. 89, pl. 12, f. 22, 23.—*Vertigo marginalba* Pfr., Poey, Memorias sobre la Hist. Nat. Cuba, ii. p. 13.—Arango, Fauna Malacologica Cubana, p. 103 (Cogimar, under stones).

This is a common shell around Matanzas (pl. 11, figs. 12, 13; pl. 10, figs. 8, 9), also in Bermuda (pl. 11, figs. 10, 11), varying considerably in shape and in the thickness of the lip. I have found beautiful albino specimens with the dark ones on the west side of Matanzas Bay, and it is evident that Pfeiffer's unique type was of this kind. The name was unfortunate, for normally the lip is colored. The degree to which the angulo-parietal lamella appears bifid varies (pl. 10, figs. 8, 9); also the projection on the columellar side, which is sometimes wanting in lots where most shells have it developed.

Variety.—In some lots the parietal and angular lamellæ are more fully concrescent, forming a nearly simple and more slender lamella, as in pl. 10, fig. 8.

Some small and slender specimens from San Vicente Baños, Cuba (pl. 10, fig. 6), taken by Henderson, appear to me to be either a race of *marginalba* or a closely related subspecies. The angular lamella forms a lobe at its junction with the parietal, the anterior end of the latter projecting on the colu-

mellar side. The lip is not much thickened, less than in typical *marginalba*.

Length 2.45, diam. above aperture 1 mm.

Length 2, diam. above aperture 0.96 mm.

Pfeiffer's original and later descriptions follow.

Pupa marginalba Pfr. Pl. 11, fig. 8. "Shell ovate-turrite, corneous, umbilicate; whorls 5, convex; lip rather thick, subexpanded, white; aperture four-toothed. Length 1⅕, diam. ½ lines. Two small teeth in the outer lip, a third, larger, in the columella, and the fourth, largest, on the penult whorl near the insertion of the lip. A single specimen." Cuba (*Pfr.*, 1840).

"Shell shortly rimate, subperforate, oblong-ovate, thin, glossy, corneous; spire subturrite, the apex rather obtuse; 5½ convex whorls. Aperture subrotund, four-toothed: one tooth on the parietal wall, one on the columella, two callous teeth in the lower part of the palate; peristome white, shortly expanded, the margins joined by a thin callous. Length 2½, diam. 1⅓ mm., aperture ¾ mm. long" (*Pfr.*, 1848).

Pfeiffer's original example was probably from Matanzas province, where he collected. Küster states that the neck is somewhat flattened, with a callous (crest) running parallel to the lip; the peristome has a pretty strong white lip. Like Pfeiffer, he describes only four teeth. Pl. 11, fig. 8, is copied from his plate.

18. GASTROCOPTA PROCERA (Gould). Pl. 12, figs. 1 to 5.

The shell is shortly rimate, cylindric, with convexly conic, obtuse summit; cinnamon to sayal-brown, paler at the summit, somewhat glossy, lightly, irregularly striate. Whorls 5¾, rather strongly convex, the last one flattened in the region of the lower palatal plica, and slightly impressed over the basal plica; having a low crest (fig. 4) close behind the outer lip (variable in prominence). The aperture has five teeth. The angulo-parietal lamella is sinuous, showing a distinct spur on the right side, in a front view; in basal view (pl. 12, fig. 5) this spur is seen to be the inner end of the angular lamella, while the parietal lamella forms a very in-

conspicuous projection of the outline on the left side, and its inner end curves slightly to the right. The columellar lamella is stout, transverse, nearly a half whorl long; below it there is a low tubercle (pl. 12, fig. 2; variable in prominence, and often not visible in a face view). The upper palatal plica is short, situated exactly opposite the spur of the parietal, and is rather deep within. Lower palatal plica is much longer, more deeply placed, its inner end reaching a dorsal position. The basal plica is short, about as deep within as the upper palatal. The peristome is thickened within by a strong, cinnamon callous ridge, in front of the lip-teeth, and excavated near the upper insertion.

Length 2.5, diam. 1.1 mm.

Length 2.3, diam. 1 mm.

Eastern United States: Maryland to South Carolina, west to Shawnee Co., Kansas, and Payne Co., Oklahoma; south to Alabama and eastern Texas. Type locality, Baltimore, Maryland.

Pupa procera GOULD, Boston Journal of Nat. Hist., iii, 1840, p. 401, pl. 3, f. 12 (bad); iv, 1843, p. 359, pl. 16, f. 12. —STERKI, Nautilus, iv, 1891, p. 140; vi, 1892, p. 4.—*Bifidaria procera* Gld., PILSBRY and VANATTA, Proc. A. N. S. Phila., 1900, p. 594, pl. 22, f. 6, 7.—WALKER, Occ. Pap. Mus. Zool. Univ. Mich., no. 15, 1915, pp. 2–10.—*Pupa carinata* GOULD, Boston Journal N. H., iv, no. 1, 1842, cover; *t. c.*, no. 3, 1843, p. 359.—*Pupa gibbosa* Say, KUESTER, Syst. Conchyl. Cab., *Pupa*, p. 123, pl. 16, figs. 13–16 (in Nordamerika und Mexico). Not of Say.—*Pupa minuta* Say, PFEIFFER, Symbolae ad Hist. Hel., ii, 1842, p. 54; Monographia Hel. Viv., ii, p. 356. Not of Say.—*Pupa rupicola* Say, W. G. BINNEY, Land and Fresh-Water Shells of N. A., i, 1869, p. 243, f. 423, 424; Man. Amer. Land Shells, 1885, p. 328. Not of Say.

G. procera differs from *G. rupicola* by its dark color, tinted or dark-colored lip, and more cylindric shape. Both have the lip heavily calloused within, but in continental *G. rupicola* the callous is always white, and the shell very pale. *G. rupicola* is an Austroriparian species, nowhere extending as far north as *G. procera*, but the latter extends south into part of

the *rupicola* territory. In some places, as at Galveston, *G. rupicola, procera* and *hordeacella* occur together in the same colony.

I have seen *G. procera* from Cecil Co., Maryland, near the Pennsylvania line, and it may be expected to occur in Pennsylvania, in the lower Susquehanna valley. There are records of "*rupicola*" from New England (Binney) and New York, which if not due to mixture of specimens or labels, as one may suspect, should pertain rather to *procera*. *G. procera* is found in the southern parts of all the states north of the Ohio River, in Missouri and Kansas (Shawnee Co.), and west as far as Perkins, Payne Co., Oklahoma (D. K. Greger); also Texas, in Lee Co., where the form seems to me intermediate between *procera* and *duplicata*. In the west it may narrowly overlap parts of the areas of the subspecies *duplicata* and *mcclungi*, and in some New-Mexican lots, from the debris of the Rio Grande and Mimbres rivers, it is rather difficult to decide whether one has *procera* or *mcclungi*.

Dr. Sterki has reported *G. procera* from Iowa and from Winona, Minnesota (Nautilus, iv, 140), places further north than any from which I have seen specimens; also Cincinnati, Columbus and Hamilton, Ohio (Proc. Ohio Acad. Sci., iv, 378). Baker recorded it from Joliet, Illinois (Moll. Chicago Area, pp. 20, 232). *G. procera* has been reported from Trinidad, Colorado (Univ. of Colo. Studies, iv, 171), but the specimens are *G. p. mcclungi*.

Pupa minuta was wrongly credited to Say by Pfeiffer, who gave the description translated below. He quoted *Pupa gibbosa* Say as a synonym, but the latter name was used only by Küster, who figured it. These figures support the opinion of Binney that the shell was merely *procera*, rather a young one, apparently.

P. minuta Say. Shell scarcely rimate, cylindric, glossy, pellucid, corneous, spire with the apex obtuse; aperture subsemicircular, four-toothed: teeth subequal, one parietal, one columellar, two palatal; peristome expanded, somewhat lipped, the margins separated, right margin arcuate above. Length 2⅔, diam. 1¼; aperture ¾ mm. in oblique length.

Habitat in Pennsylvania. Is it not likely a variety of *P. procera?* (*Pfr.*).

Pupa carinata Gould, from Maryland, was subsequently said by Gould to be an immature or broken *procera.*

18*a*. Form *riparia* (n. f.), pl. 12, fig. 6. Columellar lamella shorter, *no callous or nodule below it.* Teeth whitish, the palatals usually smaller than typical. Calera and Big Will's Valley near Valley Head, Alabama (H. H. Smith), and Galveston, Texas (type loc., Pilsbry).

18*b*. G. PROCERA DUPLICATA (Sterki). Pl. 12, figs. 7, 8; pl. 13, fig. 7.

The shell differs from *procera* by having the angulo-parietal lamella more complex, due to the less complete concrescence of the two component lamellæ; the anterior end of the parietal is visible as a low, callous branch directed towards the columellar insertion (pl. 13, fig. 7). The parietal callous between ends of the lip is usually thick. The tubercle below the columellar lamella is typically strongly developed. Peristome and crest as in *procera*, of a very pale brown tint, and the callous thickening is heaviest a little inward from the edge.

Length 2.9, diam. 1.2 mm.; nearly 6 whorls (typical).

Length 2.25, diam. 1 mm. (smallest paratype).

Distribution. — South Dakota to the Rio Grande. Type locality, Glenrose, Somerville Co., Texas.

Bifidaria duplicata STERKI, Nautilus, xxv, Feb. 1912, p. 116.

It may be that this form of the subarid region deserves specific rank, but the difficulty of distinguishing many specimens from *procera*, owing to intermediate degrees of development of the angulo-parietal lamella, causes me to consider it a subspecies. It varies in size in each colony, as usual in the group. Around New Braunfels, Texas, where it is common, the maximum length is 3.3 mm., with barely 6½ whorls.

Localities for typical *duplicata* are: South Dakota: Washington Co. (Over). Oklahoma: Fort Gibson (A. D. Brown coll.). Arkansas: Rogers, Benton Co. (Pilsbry and Ferriss). Texas: Glenrose, Somerwell Co. (type loc.); Austin; San Marcos, Hays Co.; New Braunfels, Comal Co.; near Hondo,

Medina Co.; Devil's River, Val Verde Co. (Pilsbry and Ferriss).

Nearly all of the specimens seen are from stream debris, though many are so fresh that it is not likely they had floated far. In some lots, as that from New Braunfels, the form *mcclungi* occurs in the same debris; but it seems probable that this small, thick-lipped form lives in more arid situations than the larger, darker-lipped *duplicata*. The area of *mcclungi* is much more extensive than that of *duplicata* westward, but in the east they are nearly coincident. The relations of the forms can be more exactly estimated when gatherings of living specimens come to hand.

18*c*. *G. procera mcclungi* (Hanna & Johnston). Pl. 13, figs. 1 to 5.

The average size is smaller than *procera* or *duplicata;* whorls typically shorter. The face of the thick lip is convex, and the greatest thickness of the lip-callous is at (not within) the edge of the aperture. Teeth as in *duplicata*, the angulo-parietal lamella being bifid and forked in front (fig. 5), and there is a tubercular tooth below and partially united with the columellar lamella, which appears duplicated when the subcolumellar portion is strongly developed, as in fig. 4. There is a rather low crest behind the lip, and an external impression (sometimes wanting) over the lower palatal plica.

Length 2.03, diam. 0.96 mm.; length 2.07 and 2.44, diam. 1 mm. (Hanna and Johnston).

Length 2.26, diam. 1.08 mm.; fully 5 whorls (fig. 1, Clay Co., N. D.).

South Dakota to the Rio Grande, Texas; west to eastern Colorado, the Rio Grande and Mimbres valleys, New Mexico, and Holbrook, Arizona. Type locality, pleistocene of Prairie Dog Creek, Phillips Co., Kansas.

Bifidaria mcclungi HANNA and JOHNSTON, Kansas University Science Bulletin, vii, no. 3, Jan. 1913, p. 119, pl. 18, f. 1, 2.

A subspecies of the semi-arid country, now probably extinct over much of its former territory, the limits of which are indicated above. Nearly all of the specimens known are

from stream debris. The type specimen is identical in form with figs. 1 and 2. Some specimens are longer (fig. 3). *G. p. mcclungi* is separated from *G. p. duplicata* chiefly by the character of the lip, as the shape and size of the shell are variable.

Examples have been examined from the following places; all except the type lot in coll. A. N. S. P.:

South Dakota: Indian Creek, Pennington Co.; White River, Washington Co.; Chamberlain, Brule Co.; mouth Vermillion River, Clay Co.; all collected by W. H. Over.

Kansas: Lawrence (G. D. Hanna); pleistocene of Prairie Dog Creek, Phillips Co. (Johnston; type, no. 226395 U. S. N. M.).

Colorado: Trinidad (Pilsbry); Pike's Peak (E. Hall).

Arkansas: Rogers, Benton Co. (Pilsbry and Ferriss).

Texas: New Braunfels (Ferriss and Pilsbry); Laredo (Orcutt).

New Mexico: around Las Vegas and Mesilla (Cockerell); Albuquerque (Pilsbry and Ferriss); Santa Fé (Ashmun); Mimbres River near Swartz and near Deming (Pilsbry and Ferriss).

Arizona: Holbrook (Ashmun).

Many of the shells from New Mexico and Arizona could about as well be referred to typical *procera* as to *mcclungi*. The structure of the angulo-parietal lamella is intermediate, rarely so distinctly forked in front as in typical *mcclungi*, yet showing some trace of that structure, and sometimes distinctly. The nodule below the columellar lamella is lower than in typical *mcclungi*, yet equal to that of many individuals from Dakota and Kansas. In size the New-Mexican shells run from the ordinary length of *mcclungi* to that of the largest *procera;* two shells, the largest and smallest noticed in a large lot from near Deming, N. M., measure:

Length 3, diam. above aperture 1.1 mm.

Length 2.3, diam. above aperture 1 mm.

Small specimens of *mcclungi* are very similar to the Antillean *G. barbadensis*. The lower palatal plica, however, is placed more deeply in the throat in *mcclungi*.

Specimens from Rogers, Benton Co., Arkansas (pl. 13, figs. 4, 5) have the teeth more strongly developed than any seen

from further west, the lip being very much thickened, as in the type specimen of *mcclungi*. The specimen figured measures 2.4 mm. long, 0.95 wide.

19. GASTROCOPTA CRISTATA (Pilsbry and Vanatta). Pl. 13, figs. 6, 8 to 12.

The shell is shortly rimate, cylindric, with convexly conic summit, the apex obtuse; glossy, brown, very finely, irregularly striate. 5½ rather convex whorls, the last having *a strong whitish crest* parallel to and behind the lip, and separated from it by a marked contraction. Behind the crest it is somewhat flattened over the lower palatal plica. The aperture has 5 teeth. The *angulo-parietal lamella is not in the least bifid* in front view, but has an obtuse prominence on the right side; its angular component is very low, and weakly connected with the outer lip; the parietal is high, its anterior end forming a scarcely noticeable projection on the columellar side (pl. 13, fig. 9). The columellar lamella is rather short, horizontal, and below it there is a low callous (sometimes strengthened into a small but distinct tubercular tooth). The palatal plicæ stand within the lip-callous; upper and basal ones are short, directly entering, lower plica deeply placed, shorter than in *B. procera*. The plicæ are visible on the outside as white marks behind the crest. The peristome is well expanded and thin at the edge, but there is a rather thick, pale brown callous rim a short distance within.

Length 2.8, diam. 1.2 mm.

Oklahoma: Fort Gibson (E. W. Hubbard) and Perkins, Payne Co. (D. K. Greger). Texas: 15 miles southeast of Amarillo (J. B. Henderson); Pecos River drift, High Bridge, and Rio San Filipe, Del Rio (Pilsbry and Ferriss); Laredo (Orcutt); Hidalgo (Singley). New Mexico: Santa Fe; Mountain station, Oscuro Mts., Socorro Co. (Ashmun); Mesilla (Cockerell); Albuquerque and Mimbres River near Deming (Pilsbry and Ferriss). Arizona: Navajo Springs; Holbrook; Camp Verde, Yavapai Co., type loc. (Ashmun); Salt River, Tempe; Santa Cruz R. at Tucson and Amados; San Pedro River, Benson (Pilsbry and Ferriss); Barbakoma Creek, Huachuca Mts. (Ferriss).

Pupa hordeacea Gabb, BINNEY, Terrestrial Mollusks, v, 1878, p. 205, f. 109 (bad).—STERKI, Nautilus, iv, 1891, p. 141; vi, 1892, pp. 4, 101.—*Bifidaria hordeacea* Gabb, PILSBRY, Nautilus, xi, p. 117. Not *Pupa hordacea* Gabb.—*Bifidaria procera cristata* PILSBRY and VANATTA, Proc. A. N. S. Phila., 1900, p. 593, pl. 22, f. 4, 5.—WALKER, Occ. Pap. Mus. Zool. Univ. of Mich., no. 15, 1915, pp. 4-11 (distribution).

While related to *G. procera* by its shape, color and size, this species differs by the *simpler angulo-parietal lamella*, which is *not bifid* at the summit, in a front view, and by the stronger crest behind the lip, which is further back than that of *procera*. Having collected some thousands of the species in many places, and carefully examined a great number, I find none in any way transitional to *procera*.

The variation in size is as great in most lots as in the related species. The largest and the smallest noticed in a lot from Tempe measure, length 3.2, diam. 1.3 mm., and length 2.3, diam. 1.1 mm. (pl. 13, fig. 6). The callous below the columellar lamella varies from rather low to a distinct tooth, but it is rarely so well developed as in most specimens of *B. p. mcclungi*. The projection on the columellar side of the parietal lamella also varies slightly, but it is never so strong as in well-developed *duplicata*.

G. cristata may be found in the debris of the Rio Grande almost anywhere, being brought in by tributary washes from the hills. Whether it actually inhabits the country as far down as Laredo and Hidalgo seems doubtful. It occurs also in the Mississippi River drainage in Oklahoma, and in the Colorado River drainage as far west as Yavapai Co., Arizona.

20. GASTROCOPTA RIOGRANDENSIS Sterki, n. sp. Pl. 12, figs. 9, 10.

The shell is shortly rimate; slowly tapering, less cylindric than *G. procera*, cinnamon or sayal-brown, paler towards the summit, weakly, irregularly striate, composed of 5⅓ strongly convex whorls, the last one impressed over the lower palatal plica, and having a narrow, rather strong crest parallel to the lip a short distance behind it (fig. 9). The aperture has

6 teeth. The angulo-parietal is distinctly bifid in a front view, slightly sinuous, but not forked in front; the infraparietal is a small tubercle, often very small, and wanting in many individuals (which are perhaps not completely adult). Columellar lamella is strong, transverse, a low callous (or a low tooth) below it. Upper palatal plica short, the lower long and entering deeply, but not quite so deeply immersed as a whole, as in *G. procera*. Basal plica shorter, entering. The peristome is expanded, thin at the edge, but having a thin callous rim within.

Length 2.55, diam. 1.15 mm.

Distribution. — Texas: lower Rio Grande valley, in river debris at Hidalgo (J. A. Singley) and Brownsville. Mexico: Panuco River valley, at Tampico, Tamaulipas; falls below Valles and canyon below Las Canoas, San Luis Potosi (A. A. Hinkley).

Pupa ——— STERKI, Nautilus, iv, 1891, p. 142.—*P. riograndensis* STERKI, Nautilus, vi, 1892, p. 4 (Hidalgo, Texas; no description). — *B*[*ifidaria*] *riograndensis* Sterki, PILSBRY and VANATTA, Proc. A. N. S. Phila., 1900, p. 596.

This species tapers a little more than *G. procera*, the whorls are more convex, and the lip-callous is thin, not nearly so heavy as in *procera* and its subspecies. The infraparietal tubercle is lacking in so great a proportion of the specimens which are otherwise adult that it cannot be depended upon for identifying the species.

It stands very close to *G. servilis* Gld., but differs by having a strong, narrow crest behind the outer lip, while in *servilis* a crest is completely wanting. Also, when typically developed, the lip is a little thickened in *riograndensis*, and an infraparietal tooth may be present. The crest behind the lip distinguishes *riograndensis* from the Ecuadorian *G. wolfiii*, which is otherwise very similar.

The figured type is no. 60137 A. N. S. P., from Hidalgo, Texas.

21. GASTROCOPTA SERVILIS (Gould). Pl. 14, figs. 4, 5, 6, 7.

"Shell elongated; tapering to a somewhat acute apex, of a

pale chestnut or horn-color; whorls five and sometimes somewhat more, very delicately wrinkled; suture well defined. Aperture semi-oval, nearly in the axis of the shell, the transverse portion slightly oblique, and the two extremities of the lip very nearly meeting behind. Revolving under the middle of the transverse lip is a contorted, lamellar tooth which arises near the junction of the outer lip; on the middle of the columella is a large conical tooth; at the base is a small tooth, then a third large tooth, placed so as to form a regular tripod with the other two, and above this is a fifth inconspicuous tooth. Lip slightly everted, not flattened, sometimes a little inflected at the right; umbilicus small. Length one-tenth, breadth one-twentieth inch'' (*Gould*). [Length 2.5, breadth 1.25 mm.]

Bermuda (Verrill, Vanatta, and others). Bahamas: near Ft. Charlotte, Nassau, N. P. (Owen Bryant in U. S. Nat. Mus.).

Cuba: near Matanzas (type loc.; Bartlett; Pilsbry); Santa Cruz (Dr. Griffiths); El Vedado, near Havana (Pilsbry); Viñales; Cabañas, at the Light; Sumidero (Henderson); Yateras (Wright, in Henderson coll.).

Haiti: Charmettes (Henderson and Simpson); Yuma (H. Prime, in Henderson coll.).

Jamaica: near Port Antonio and Hope River (Henderson and Simpson); Montego Bay and Mandeville (A. P. Brown); Castle Daly (Clapp).

Porto Rico: San Juan; also Viéques (T. Bland).

St. Thomas and St. John (Bland). St. Croix (R. Swift; Griffith). Antigua (W. R. Forrest). St. Bartholomew (Dr. Cleve).

Guadeloupe (E. Marie). Barbados (L. P. Brown).

Mexico: Vera Cruz (Orcutt and H. Strebel, in U. S. N. M.; Crawford, in A. N. S. P.). Yautepec, Moreles; Merida, Yucatan (Heilprin exped.); Carmen Island (Morelet).

Bluefields, Nicaragua (W. H. Fluck). Panama (Paz).

Pupa servilis Gould, Boston Journal of Natural History, iv, 1843, p. 356, pl. 16, f. 14.—*Pupa pellucida* Pfr., Strebel, Beitrag Mexikanischer Land- und Süsswasser-Conchylien, iv,

p. 91, pl. 4, f. 19; pl. 15, f. 10.—Von Martens, Biologia Centrali-Americana, p. 328, in part; and of many other authors. —*Vertigo pellucidus* Pfr., Arango, Fauna Malacologica Cubana, p. 103, in part.—? *Pupa bermudensis* Prime, The Bermuda Almanac for 1852.—Jones, The Naturalist in Bermuda, 1859, p. 107 (name only).

"At first sight this species would be referred either to *P. rupicola* or *P. procera.* But a closer examination shows that while it has the pale brown lip of the latter, it is a shorter and much more ventricose shell; and while the number and arrangement of the teeth are as in *rupicola*, the latter has a much more slender form, the aperture is more oblique and less elongated, the apex is obtuse, and the lip is white" (*Gould*).

This species differs from *G. procera* and *G. rupicola* by the *absence of an internal thickening of the lip*, which is well expanded but thin. There is *no external crest.* The columellar lamella is simple, without a callous or tubercle below it. The angulo-parietal lamella is not forked in front, but there is a very low and inconspicuous projection on the columellar side, marking the anterior end of the parietal portion.

One of the commonest Antillean species. It was well described by Gould, but subsequently was for a long time merged into the group of forms known collectively as *Pupa pellucida.* Dr. Pfeiffer seems to have initiated this lumping, in which he was followed by Binney and many other authors. It is certainly related to *pellucida*, but differs by being constantly larger and generally of darker color. The shortest individuals of *procera* are broader than the largest *G. pellucida. G. rupicola* and its subspecies differ by the thick lip and spurred angulo-parietal lamella, but immature shells are much alike.

The typical form of *servilis* has a tapering shell of about 5½ whorls, the summit very obtuse. There is no crest behind the outer lip, but the whorl is flattened over the lower palatal plica. The peristome is thin and brown, its margins rather remote. The angulo-parietal lamella shows a small lobe on the right side, in front view, caused by the slight outward flare of the inner end of the angular. The front end of the

parietal is typically not distinct (but in some forms there is a *very small* projection on the columellar side). Columellar lamella enters horizontally and is without accessory denticles or callous deposit within. The basal and upper palatal plicæ are small tubercles, but the lower palatal is somewhat lengthened and a little more deeply placed. The shell drawn in figs. 5 and 6 measures, length 2.45, diam. nearly 1.1 mm.

Like some other Gastrocoptas, there is a rather wide range of individual variation in size. An extremely short, conic form from Somerset, Bermuda, is drawn in pl. 14, fig. 7; length 2, diam. 1.1 mm. I have seen several examples, but as they were picked out of normal lots, it is not likely that they represent a race.

The specimens from Porto Rico, St. Thomas (pl. 14, fig. 4), Guadeloupe and some others have the inner end of the angular lamella more prominent, forming a distinct spur in a front view. Part of the Mexican shells are similar.

To the localities given above for this species, all verified by myself, Guatemala might perhaps be added, as Professor von Martens gave several places in that country for "*P. pellucida*," with which he unites *servilis*.

Pupa desiderata Weinland. Pl. 14, fig. 10. Shell broadly and deeply rimate, ovate-cylindric, corneous, thin, slightly obliquely striate under a strong lens; spire moderately tapering, the apex obtuse; suture rather impressed; whorls 5, convex, the last shorter than the spire; aperture subvertical, truncate-ovate, obstructed by a long parietal and another smaller and more deeply placed palatal tooth, opposite to the parietal; peristome corneous, thickened, expanded throughout, the right margin somewhat sinuous, right and basal margins a very little reflected. Length 2¼, diam. above the middle 1 mm.

Gonave Island, off Haiti, under stones (Dr. Brown), a single specimen in the Bland collection.

Pupa desiderata Weinland, Jahrbücher der Deutschen Malak. Ges., vii, 1880, p. 377, fig. in text.

It may be suspected that *Pupa desiderata* is either a small bleached *B. servilis* or a form of *B. pellucida*. Both of these

species are known to occur in Haiti. It is practically certain that Weinland did not see all of the teeth, only the angulo-parietal and upper palatal being noticed by him. There must certainly be a columellar lamella, and I suspect lower palatal and basal plicæ also, though these might be degenerate, as in *G. s. riisei.*

21*a*. *G. servilis riisei* (Pfeiffer). Pl. 14, figs. 8, 9.

The shell differs from *G. servilis* by the oblong, less conic shape; the teeth are smaller; the parietal lamella is lower; a basal fold is absent, and the upper palatal plica is small or often wanting. Length 2.2, diam. above aperture 1 mm. Otherwise like *G. servilis.*

The series examined comprises 9 specimens from St. Thomas (Henderson collection, from that of Prof. Theo. Gill), and 20 from Water Island, near St. Thomas (Academy coll., from Thomas Bland). By the thin lip, color, etc., it seems to be a local derivative of the widespread *G. servilis*, comparable to *G. p. parvidens* Sterki, a much smaller shell. By the weakness of the upper palatal and basal plicæ it resembles the form described as *oblonga* Pfr., but that is much paler in color, and probably to be looked upon as a parallel modification of *servilis.*

I presume that this form is Pfeiffer's *riisei*, which was described as follows:

Pupa riisei. Shell subrimate, ovate-cylindric, thin, most minutely striate, somewhat glossy, pellucid, pale corneous; spire gradually tapering, the apex obtuse; suture simple; whorls 5, convex, the last one-third the length, rounded at base; columella subplicate; aperture slightly oblique, oval-oblong, toothless; peristome thin, narrowly expanded throughout. Length 2.5, diam. 1 mm., aperture scarcely 1 mm. long (*Pfr.*).

St. Thomas, type loc., and Porto Rico (Riise).

Pupa riisei Pfr., Zeitschr. f. Malak., 1852, p. 151; Monogr. Hel. Viv., iii, p. 532; iv, 684, as var. of *pellucida.*—? *Pupa riisei* Pfr., Kuester, Syst. Conch. Cab., p. 178, pl. 21, f. 13, 14.

Pfeiffer considered *P. riisei* a variety of *P. pellucida* in the

later volumes of the Monographia Heliceorum, defining it thus: "A little larger, with a few teeth, sometimes almost entirely obsolete." Küster described a specimen from Pfeiffer's collection as having five teeth, in the typical *Gastrocopta* positions. His figure shows teeth as large as in *G. servilis*, and probably what he had was that species. It may be surmised that Pfeiffer had the form deficient in teeth mixed with *servilis;* or, indeed, his original description might have been from an immature specimen of either.

22. GASTROCOPTA PELLUCIDA (Pfeiffer). Pl. 15, figs. 1-3, 5.

"The shell is small, cylindric, subperforate, pellucid, glossy, pale yellowish, most minutely striate, the apex rather obtuse; whorls 5½, a little convex; aperture oblong, toothed; two large teeth on the columella, 3 or 4 very minute teeth in the circuit, not reaching to the edge; peristome simple, a little reflected. Length ⅘, diam. ⅖ of a line [= 1.66 : 0.83 mm.]. Cuba" (*Pfr.*, 1841).

"The shell is subperforate, cylindric, thin, pellucid, glossy, pale yellowish; spire gradually tapering, apex obtuse; whorls 5, convex, the last one flatter than the preceding; aperture semi-oval, five-toothed: single strong teeth on the parietal wall and the columella, two of moderate size in the right margin, and a fifth small one in the base of the palate; peristome simple, the right margin expanded, columellar margin reflected. Length 2, diam. scarcely 1 mm.; aperture scarcely ⅔ mm. long. Sometimes there is a fourth palatal denticle" (*Pfr.*, 1848).

West Indies: Bahamas, Cuba, Jamaica, Haiti, Porto Rico, Vieques, and eastern Mexico; varieties *hordecella* and *parvidens* in the southern United States.

Pupa pellucida PFR., Symbolæ ad Hist. Hel., i, 1841, p. 46; Monographia Hel. Viv., ii, 1848, p. 360; vi, p. 331.—KUESTER, Syst. Conchyl. Cab., p. 89, pl. 12, f. 24, 25, 25*.—VON MARTENS, Biologia Centrali-Americana, p. 328 (in part).—*Pupa jamaicensis* C. B. ADAMS, Contributions to Conchology, no. 3, p. 37.—GLOYNE, Journ. de Conchyl., 1875, p. 121.—PFEIFFER, Mon. Hel. Viv., iii, p. 558.—KUESTER, Syst. Conchyl.

Cab., p. 138, pl. 17, figs. 27, 28. — *Vertigo pellucidus* Pfr., Arango, Fauna Malac. Cubana, p. 103 (in part).—*Pupa hordeacella* Pilsbry, Proc. A. N. S. Phila., 1890, p. 44, pl. 1; f. *g, h, i, j, k.*—*Bifidaria hordeacella* Pils. & Van., Proc. A. N. S. Phila., 1900, p. 594, pl. 22, f. 3.—Vanatta, Nautilus, xxvi, 1912, p. 17, pl. 2, f. 1-27 (variation).—Walker, Occ. Papers Mus. Zool. Univ. Mich., no. 15, 1915, pp. 2-11 (distribution).

G. pellucida is cylindric-oblong, diameter almost equal at the last two whorls, those above tapering convexly to an obtuse apex. The color is "corneous"—that is, an imperfectly transparent, very pale grayish-buff, but on red soils the thin cuticle becomes stained, slightly cinnamon in some cases. The striation is well developed. The last whorl is strongly flattened over the lower palatal plica, and has no trace of a crest or ridge behind the lip. Peristome expanded, very slightly thickened within, corneous, the terminations remote. The angulo-parietal lamella is not very conspicuously bifid in front view. Seen from below (pl. 15, fig. 5) it consists of a straight, grayish angular lamella highest at its junction with the parietal, and a thicker, more opaque whitish parietal lamella, the front end of which curves slightly towards the columella, forming a minute projection on that side a little forward of the middle of the whole lamella. The columellar lamella is stout, horizontal, and has a small callous below its inner end, often not visible in a front view. The lower palatal plica is larger than the upper, and is placed a little deeper. Basal fold short but distinct. As in other Bifidarias, there are sometimes abnormalities in the palatal region, plicæ being doubled, or irregular ones interposed.

Length 1.75, diam. 0.8 mm.; 5 whorls.

Length 1.7, diam. 0.75 mm.; nearly 5 whorls.

G. pellucida has been used to cover almost any species of its group, as I gather from the literature and the named specimens in various museums. The original account and Kuester's figures are not very satisfactory. The above description and pl. 15, figs. 1-3, 5, are from typical Cuban specimens. Its recognition marks are the small size (1.5 to 2.2 mm. long), faintly yellowish-corneous tint, rather indis-

tinctly bifid angulo-parietal lamella with a small projection on the columellar side, seen in a basal view, the absence of any crest behind the lip, which while slightly thickened within has no distinct white or brown callous, and the rather short lower palatal plica.

It differs from *G. servilis* by the smaller size, *especially the smaller diameter;* this dimension varying within narrower limits than the length. *G. barbadensis* has the angulo-parietal lamella much more distinctly bifid, in a front view of the aperture; the lower palatal plica is longer and more deeply placed; and when typically developed, the teeth are larger than in *pellucida.*

Typical *pellucida* is before me from La Guira, S. Diego, El Abra, Viñales, Sierra de S. Vicente (1.7 x 0.75 mm.), all from the John B. Henderson collection, and from some other Cuban localities. Specimens from Jamaica, Port Henderson (Swift coll.) and Mandeville (A. P. Brown), are entirely typical. In the Bimini group of the Bahamas it occurs at South Bimini Cay (length 2.1 to 2.3 mm.) and north end of South Cat Cay, both collected by Geo. H. Clapp, 1912, the shells vary from typical size to somewhat larger.

Variation may be noted as follows:

a. Typical in size or larger, the angulo-parietal lamella not showing any projection on the columellar side, or with it scarcely noticeable. Cuba: San Juan de Letran, near Trinidad, the largest 2.15 x 0.9 mm., and El Vedado, Havana (Pilsbry). Teneria de Guane; Costanera del Abra, Pinar del Rio; Cabañas Light, and Laguna de Piedra (Henderson). Haiti: Charmettes and St. Mark (Henderson and Simpson). Vieque. Also Antigua, state of Vera Cruz, Mexico (S. N. Rhoads), the largest one 2.2 mm. long, 0.95 wide.

b. Lots from Costanera de S. Vicente, Guane, and Mogote de la Mina, Consolacion del Norte, are more or less intermediate between the typical form and the variety *a.*

c. One lot from Ponce, Porto Rico (R. Swift) has a small crest behind the lip, and the color is pale brownish. It differs in no way from the continental *hordeacella.*

22*a*. *G. pellucida* form *biminiensis*, n. f. Pl. 15, figs. 11, 12, 13.

The shell is dark brown, having a crest or trace of it behind the lip; lip widely reflected and moderately thickened, but not nearly so thick as that of *crassilabris*. Angulo-parietal lamella *nearly straight and not bifid*, resembling that of *B. pellucida*. No buttress under the columellar lamella.

Length 2, diam. above aperture .9 mm.; 4¾ whorls (type).

Length 2.15, diam. above aperture .9 mm.; 5 whorls.

Bimini Islands: north end of South Cat Cay and South Bimini Cay, type locality (Geo. H. Clapp).

In a series from Rosario, Cuba (Henderson), the lip is a little thicker than usual in pellucida, about as in form *biminiensis*. The angulo-parietal lamella is nearly straight and simple in some individuals (pl. 15, fig. 10; length 1.6, diam. 0.75 mm.); but in others the angular and parietal lamellæ are not in alignment, the tooth in basal view resembling that of *crassilabris*, pl. 18, fig. 9. The figured shell of this kind measures, length 1.8, diam. 0.8 mm. (pl. 15, fig. 7). The smallest shell in this lot is 1.5 mm. long (fig. 10).

22*b*. *G. pellucida delicata* n. subsp. Pl. 15, figs. 4, 9.

The shell is smaller, very thin and fragile, slightly paler than marguerite yellow, without a crest behind the thin lip. The angular lamella is very weak and low, the parietal and columellar lamellæ moderately developed. Basal fold wanting, or very minute when present.

Length 1.55, diam. above aperture 0.7 mm.; 4⅓ whorls.

Length 1.36, diam. above aperture 0.65 mm.; 4 whorls.

Distribution.—North end of South Cat Cay, Bimini group, Bahamas (Geo. H. Clapp, May, 1912). Cotypes in collections of Clapp, A. N. S. P., and J. B. Henderson.

This very minute and fragile form contrasts with the subspecies *biminiensis* of the same islands, and both seem well differentiated from *pellucida*.

22*c*. *G. pellucida hordeacella* (Pilsbry). Pl. 17, figs. 1 to 4; pl. 16.

This continental race differs from *pellucida* by having a

slight crest behind the outer lip, and a somewhat longer lower palatal plica. There is often no projection on the columellar side of the angulo-parietal lamella. Also by the pale brown color and the *average larger size*. In the original description a specimen of the minimum size was selected as type, but in the same lot the size is variable, from length 1.8, diam. 0.76 mm., to length 2.5, diam. 1 mm. All of the characters distinguishing *hordeacella* from *pellucida* vary so much that in some individual cases, without a large series, there is little or no difference; but it is only the smallest individuals of any lot of *hordeacella* which could be taken for *pellucida*. The status of the subspecies is rather uncertain, and possibly it might be abandoned with advantage.

There are specimens which show no crest, and the color, in the East, is often as pale as *pellucida*.

G. p. hordeacella varies far more than Antillean *pellucida*. The length varies from 1.5 to 2.6 mm., whorls 4 to 5½, among specimens picked from one lot. Mr. Vanatta remarks (Nautilus, xxvi, p. 17) that in picking them over one has a tendency to divide each lot into several grades, long, medium, small and obese, but these intergrade through a small number of shells of intermediate size. "The long shells from Florida have weak teeth and the short specimens have strong teeth, while in Texas the converse is often the case." There is considerable variation in the development of the buttress under the columellar lamella, which is sometimes scarcely noticeable, sometimes so thick as to appear as a subcolumellar tubercle. See pl. 16, figs. 5, 10, 26.

Florida and the Keys, Georgia Sea Islands north along the coast to Cape May, New Jersey. Ft. Gibson, Oklahoma, and Texas, west to Trinidad, southeastern Colorado, Jerome and Mt. Trumbull, Arizona. Guajadami, Lower California (Nelson and Goldman). Victoria (S. N. Rhoads) and Tampico, Tamaulipas (Hinkley); near Valles, S. L. Potosi (Hinkley). Type locality, New Braunfels, Texas.

On the Atlantic coast, though it extends as far north as Cape May, its extension inland seems to be very narrow, so far as the data show. In the west it is generally diffused,

being found almost anywhere snails live in Texas, New Mexico and Arizona, between the 97th and 113th meridians, except in the higher mountains. About 150 lots are in the collection of the Academy.

Specimens from a dry cliff in the very arid Big Hachet Mts., N. M., near the Mexican boundary, are all small, length 1.8, diam. 0.72 mm., very pale buff, and without a crest behind the lip.

The examples from Guajadami, Lower California, are paraffine-whitish, rather long and narrow, fig. 4 measuring, length 2, diam. 0.72 mm. The crest behind the lip is very low but perceptible. This locality is widely separated from the rest of the known occurrence of *hordeacella.*

Mr. Vanatta has published a series of figures, drawn to the same scale with the camera-lucida, to illustrate the very great variation in size and shape in this subspecies. His plate is reproduced in plate 16, the specimens illustrated being from the following localities:

Figs. 1, 3, 5–8, 12, 13, 15, 16, 20–22, Key West, Florida. No. 104029.

Figs. 9, 10, 14, 17–19, 25, Bahia Honda Key, Fla. No. 105521.

Figs. 4, 24, 26, 27, Summerland Key, Fla. No. 102742.

Figs. 2, 11, 23, New Braunfels, Texas. No. 68888.

Each lot contains specimens from a single station of only a few feet extent, except the New Braunfels lot, which was from stream debris. By its great variability and often larger size, *hordeacella* contrasts with *pellucida.*

22*d*. *G. pellucida parvidens* Sterki. Pl. 17, fig. 8.

"Quite small; apex more acute than in typical examples [of *hordeacella*] and outline more obovoid; peristome rather abruptly but narrowly everted; lamellæ and folds small, especially so the upper palatal, often being a mere trace; basal absent or very small; color pale horn. Alt. 1.5 to 2 mm." (*Sterki*).

Size and shape are variable in this race, which differs from *hordeacella* by the smaller lamellæ and plicæ, the angular

lamella being short, not reaching to the lip, the columellar lamella has no buttress below, and the basal fold is generally wanting. Sometimes, as in the specimens from Navajo Springs, both basal and upper palatal folds are wanting.

Arizona: Mescal Gulch and drift of Verde River, near Jerome, Yavapai Co. (type loc.); Navajo Springs, Apache Co. (Ashmun).

Bif. hordeacella Pils. var. *parvidens* STERKI, Nautilus, xii, March, 1899, p. 128.—*Bifidaria hordeacella parvidens* Sterki, PILSBRY and VANATTA, Proc. A. N. S. Phila., 1900, p. 594, pl. 22, fig. 2.

This race, though not rare around Jerome, seems to have a rather restricted area. I have collected for years in the regions north and south without encountering it. It has reached about the same stage of decadence as *G. servilis riisei* in St. Thomas, and differs from that form by the slightly smaller, especially narrower dimensions, and the noticeably deeper suture. No doubt *parvidens* is a derivative of *hordeacella*.

The descriptions of *P. jamaicensis* and *P. ovum-formicæ*, which I consider synonyms of *pellucida*, follow:

"*Pupa Jamaicensis.* Shell cylindrical; pale brownish-horn color; with fine oblique striæ of growth; spire tapering only near the summit into an obtuse apex; whorls five, quite convex, with a deep suture; aperture semi-oval, with the right side longer, and shouldered above, and the transverse side a little oblique; to the right of the middle of the latter is a very promient [prominent] stout tooth; on the middle of the columella is another equally stout, but less prominent; on the right side is another prominent tooth directed between the two above-mentioned, and on each side of it a rather smaller tooth; lip moderately reflected, with a very small umbilicus.

"This species is more exactly cylindrical than *P. servilis* Gould, *P. procera* Gould, etc., which have a similar aperture; the upper and lower teeth of the right side are more conspicuous, and the shell is much smaller. Length .07 inch; breadth .025 inch" [= length 1.75, diam. 0.625 mm.]. Jamaica (*C. B. Adams*).

Pupa pellucida was not known to Adams when he described

jamaicensis, which is exactly synonymous with Pfeiffer's Cuban species. Kuester's figure is very poor and incorrect.

Pupa ovum formicae (pl. 15, fig. 6). Shell very small, rimate, cylindrical, under a lens delicately obliquely striatulate, buff-corneous, thin; spire with obtuse apex; suture a little impressed; whorls 5, slightly convex, the last shorter; aperture subquadrangular, with one compressed parietal tooth, a wider one on the columella; peristome thickened, a little expanded throughout. Length 1⅔, diam. ⅔ mm. (*Weinland*).

Haiti: in mould under rocks in the woods at the Habitation Debarras, a few hours from Jeremie (Weinland).

Pupa ovum formicae WEINLAND, Jahrbücher der Deutschen Malak. Ges., vii, 1880, p. 377, fig. in text.—*Pupa myrmecoon* CROSSE, Journ. de Conchyl., xxix, 1891, p. 152.

This and the preceding species [*P. desiderata*] are, so far as we know, the first small Pupas of the group *Pupilla* Leach to be made known from Haiti; and the first belongs to the *abbreviatae* (of von Martens), the second to the *cylindricae*. All of these [other West Indian] species have either fewer or more than two teeth, and each has besides other characteristic features (*Weinland*).

Notwithstanding the alleged absence of basal and palatal plicæ in *ovum formicae*, I have very little doubt that it is merely *pellucida* in which the smaller teeth were present as usual, but were not seen. Such oversight is not unusual in the literature of *Pupillidæ*, incredible as it may appear.

Considering *ovum formicae* objectionable as a name, Crosse substituted *myrmecoon;* he had not seen the species.

23. GASTROCOPTA LONGURIO (Crosse). Pl. 15, fig. 8.

Shell rimate, elongate, thin, marked with fine oblique striæ, inconspicuous and scarcely visible under a lens, subtranslucent, corneous, shading into dirty white. Spire lengthened, terminating in an obtuse summit. Suture not strongly marked. Whorls 5, a little convex, the last shorter than the spire. Aperture nearly round. Peristome subcircular, almost continuous, shortly expanded and dirty white;

margins joined by a quite thick callous; parietal and columellar margins each having one lamelliform, deeply placed and conspicuous tooth; basal margin indistinctly two-toothed, both in the depth of the aperture; outer margin sometimes provided with a tooth below the point of insertion, but this is not constant.

Length 2¼, diam. ¾ mm. (*Crosse*).

Curaçao (H. Raven).

Pupa longurio Crosse, Journal de Conchyl., xx, 1872, p. 158; xxi, 1873, p. 42, pl. 1, f. 2.

This species is evidently related very closely to *G. pellucida*, having teeth in the typical positions, but it differs by the narrower contour. I have not seen specimens. The name *longurio* has been used by Moquin–Tandon for a variety of an European species, but until specimens from Curaçao can be critically compared with *pellucida*, the desirability of a new name need not trouble us.

24. Gastrocopta barbadensis (Pfeiffer). Pl. 18, figs. 1 to 5.

The shell is subperforate, ovate-oblong, thin, nearly smooth, pellucid, transparent-buff. Spire a little convex, gradually tapering, the apex rather obtuse. Whorls 5½, rounded, the last scarcely one-third the total length. Aperture oblique, lunate-rotund; parietal wall bearing a strong fold at the angle; columella deeply dentate-plicate. Peristome simple, a little expanded, the basal margin armed within with one tooth. Length 2¼, diam. ¾ mm. (*Pfr.*).

Cuba: Viñales; Sierra de S. Vicente; Cayo Piedra; Varadero Park, near Cardenas (Henderson). Water Island, near St. Thomas (R. Swift). Guadeloupe. Barbados (type loc.; L. B. Brown). Also, Trinidad (Guppy, for *P. uvulifera*), and Fernando Noronha (for *P. solitaria*); a variety in Bahamas and Bermuda.

Pupa barbadensis Pfr., Monographia Hel. Viv., iii, 1853, p. 554; iv, 679; Proc. Zool. Soc. Lond., 1852, p. 69 (1854).—Kuester, Syst. Conchyl. Cab., p. 175, pl. 21, f. 8, 9.

Includes *P. uvulifera* and *P. auriformis* Guppy, *P. indigena* Ancey and *P. solitaria* Smith.

In his description in the P. Z. S., Pfeiffer gave the length as 2¾ mm., evidently an error. Kuester, who described and figured a specimen from Pfeiffer's collection, noted and figured the palatal plicæ, which Pfeiffer omitted to mention; also the nodules above and below the columellar lamella. This specimen may be considered the type.

The shell averages a little larger than *G. pellucida*, and when fresh is of a light brown color. The angulo-parietal lamella is more sinuous than in either *pellucida* or *servilis*. *In front view it appears strongly bifid.* In a specimen in which the base has been broken away (pl. 18, fig. 3) the parietal lamella is seen to be thick, terminating forward in a low projection towards the columella. The angular lamella is thinner, and where it joins the parietal is strongly bent towards the periphery, forming a small lobe. The columellar lamella is stout and horizontal, with a callous below its inner end. This callous may be quite low, not visible in a front view, or it may be strongly developed, appearing as a subcolumellar nodule. Among specimens evidently mature one finds such variation in the same lot, but in some lots the nodule does not seem to be developed. A similar callous, rarely nodular (as in pl. 18, fig. 1, and in Kuester's figure), is on the axis above the columellar lamella, but this supracolumellar nodule is often very weakly developed. The form with well-developed supra- and infra-columellar nodules may be considered typical *barbadensis*, since this is what Kuester figured from Pfeiffer's collection. The lower palatal plica is larger than the others, and enters more deeply. The basal fold is often quite small. The peristome is pale brown, and from very slightly thickened to distinctly so, yet not so thick as in *G. rupicola*. There is sometimes a very low indication of a crest behind the lip, but more often none. The shape varies somewhat — from oblong to oblong-conic, the summit always very obtuse. In color it is wood-brown, fading to corneous at the apex. Dead shells bleach under the tropical sun to grayish-buff or almost "corneous," preserving a fresh appearance. Measurements of Barbados shells follow:

Length 2.05, diam. above aperture 0.85 mm.

Length 2.1, diam. above aperture 0.9 mm.

Length 2.4, diam. above aperture 0.95 mm.

Length 2.45, diam. above aperture 1.1 mm.

The specimens from the Cuban localities Cayo Piedra and Sierra de S. Vicente have rather weak teeth for this species, but in those from Varadero Park the teeth are as large as usual, the angulo-parietal variable in degree of concrescence. They are also small, length 1.63 to 1.7, diam. 0.75 mm. (pl. 18, figs. 10, 12).

24*a*. *G. barbadensis crassilabris* n. subsp. Pl. 18, figs. 6 to 9.

The shell is cylindric, the upper third tapering to a very obtuse apex, very pale brown, fading to corneous above. Whorls strongly convex, the last flattened, tapering downward in its last third, having a low crest behind the outer lip. Angulo-parietal lamella emarginate or bifid in front view, the front end of the parietal projecting a little towards the columella. Columellar lamella, basal and palatal plicæ well developed. Peristome expanding and *strongly thickened within*, pale brown.

Length 2, diam. above aperture 0.9 mm.; 4½ whorls (type).

Length 2.2, diam. above aperture 0.9 mm.; 5 whorls (largest).

Length 1.8, diam. above aperture 0.8 mm. (smallest).

Bahamas: near Fort Charlotte, Nassau, N. P., and Mangrove Cay, Andros Island (O. Bryant); type and paratypes from the latter locality, no. 180645 U. S. N. M. Also Bermuda: Somerset (Vanatta) and Paynter's Vale (Peniston).

The cylindric shape and small diameter distinguish this from the thick-lipped *marginalba* and *rupicola*, both of which are known to me by great numbers of specimens, from numerous localities. In shape and size, *crassilabris* resembles *pellucida*, but the thick lip and the teeth are more like *marginalba*, the peristome being thicker and the crest stronger than in *barbadensis*. There is a marked resemblance between *crassilabris* and *G. mcclungi*.

There is an albino shell in the type lot.

The Bermuda form, from Somerset (Vanatta; pl. 18, fig.

6) and Paynter's Vale (Miss Peniston) is *brown*, solid, with a crest behind the lip rather well developed in most examples; teeth well developed, but without nodules above or below the columellar lamella. Parietal lamella is more conspicuously bifid in front view than in the Andros examples, quite as in *barbadensis*, from which it differs by the very thick lip. Length 2.15, diam. 1.05 mm.

Those from near Fort Charlotte are somewhat larger, up to 2.4 mm. long, 0.95 wide. The angulo-parietal lamella is either emarginate or more strongly bifid.

No differential specific characters have yet been assigned for the following forms, which may be provisionally considered synonyms of *barbadensis*. As further examination of good series may possibly show that there has been racial differentiation, their descriptions and synonymy are given separately.

Pupa indigena Ancey. Shell small, oval, rimate, corneous-brown. Spire with obtuse apex; whorls 5½, regularly and moderately increasing, all convex, the last whorl rotund, very lightly compressed at the aperture. Aperture rotund-oval, with 5 teeth: one, the largest, superior, at the right margin, lamelliform and entering; two within the right margin; one below; and the other large one on the columella. Peristome expanded, reflexed, not covering the umbilicus, margins joined by a thin callous. Length 2¼, diam. 1¼ mm. (*Ancey*).

Guadeloupe (Ancey; Schramm, Maze and others).

Pupa indigena Ancey, Le Naturaliste, i, March, 1881, p. 373.—Maze, Journal de Conchyliologie, xxxi, 1883, pp. 21, 43.

Maze has given numerous localities on Guadeloupe and its immediate dependencies, where it seems to be a common species on calcareous terranes, living "in the crevices of old walls and in the sand under dry stones on a clay soil."

Specimens collected by Schramm are in the collection of the Academy, figured on pl. 18, figs. 4, 5.

Two measure:

Length 2.2, diam. above aperture 0.92 mm.

Length 1.9, diam. above aperture 0.89 mm.

The lower palatal plica is slightly longer than in Barbados

G. barbadensis, the columellar lamella is but slightly or not at all buttressed below, and there is no subcolumellar tubercle, though there may be a low callous (fig. 4). The lip is rather thick. It does not seem specifically separable from *G. barbadensis*, but perhaps is distinguishable as a subspecies or local race.

According to Ancey, the specimens formerly reported as *Pupa eyriesii* Drouet from the French Caribbees are referable to *indigena*.

Pupa uvulifera. Pl. 18, fig. 11. Shell umbilicate, cylindric, a little ovate, lightly striatulate, corneous-brown, little shining; whorls 5 to 6, convex; aperture semiovate, provided with folds, parietal fold vertical, lamelliform; outer margin thickened, reflexed, columellar margin broadly reflexed; umbilicus open, not very deep. Length 3, diam. 1 mm. (*Guppy*).

Trinidad (Guppy).

Pupa uvulifera GUPPY, Ann. and Mag. of Nat. Hist. (4 ser.), i, June, 1868, p. 411, no. 9; Proc. Sci. Asso. Trinidad, 1869, p. 243 (copied in PFR., Monographia, viii, p. 373); Journ. of Conch., vii, p. 219.—E. A. SMITH, Journ. of Conch., viii, 1896, p. 244, pl. 8, f. 10.

I have not seen this form, which has not been defined adequately. Guppy's measurement is clearly wrong, "length 3 millim." probably being a slip for length 2 mm. Mr. Smith's size-mark is 2.3 mm. long, and the diameter of his figure is nearly half the length, a normal proportion for the group. It is not clear how the Trinidad species differs from *G. barbadensis* (Pfr.), and until differential characters are indicated it may be placed provisionally in the synonymy of that species.

Mr. Smith, whose figure is copied on my plate, remarks: "Specimens of this species, presented to the British Museum by Mr. Guppy, exhibit five unequal teeth, viz.: a double parietal tooth larger than any of the other teeth, a single columellar tooth, and three palatal teeth, of which the uppermost on the right nearest to the parietal is very small and difficult of observation. *P. pellucida* Pfr. is very closely allied to this species."

In his Trinidad list of 1893 Mr. Guppy remarked: "I think it possible that the shell I described as *Pupa auriformis*, and of which I never found more than a single specimen, may be a variety or accidental form of this" [*P. uvulifera*]. The original description follows:

Pupa auriformis. Shell subperforate, ovate, brown, somewhat pellucid, lightly striate, scarcely shining; whorls 4½ to 5, convex, the last more than half the total length; spire short, convex, apex obtuse; aperture semioval, auriform, provided with a parietal fold; peristome thickened, reflexed, the outer margin strongly sinuated, columellar margin widely reflexed. Length 2, diam. 1½ mm. Distinguished from the last [*P. uvulifera*] by its shorter and more ovate figure. Trinidad (*Guppy*).

Pupa auriformis GUPPY, Ann. and Mag. Nat. Hist. (4 ser.), i, June, 1868, p. 441, no. 10; Journ. of Conch., vii, p. 219.

24*b*. *G. barbadensis solitaria* (E. A. Smith). Pl. 17, figs. 11, 12.

Shell minute, rimate, whitish, ovate-cylindroid; whorls 5, convex, sculptured with delicate growth-lines, separated by a slightly oblique suture, the last whorl somewhat varicose behind the lip. Aperture small, five-toothed; a strong, double columellar tooth, a smaller one, also bifid, on the parietal wall, two small ones remote from the right margin, and a fifth minute basal tooth. Peristome narrowly expanded, white, the margins joined by a thin callous. Length 2⅓, diam. 1¼ mm. (*Smith*).

Distribution.—Platform Island, Fernando Noronha (Ridley).

Pupa solitaria E. A. SMITH, Journal of the Linnean Society, Zoology, xx, 1890, p. 501, pl. 30, f. 10, 10*a*.

This species is a trifle less cylindrical than *P. pellucida* Pfr., a Cuban species; but it has the number of teeth and their arrangement similar. The columellar tooth, however, is double, the upper portion of it being most prominent; the tooth above it, upon the body-whorl, is single, bifurcating at the end. The three remaining teeth are rather remote from

the margin of the aperture. The anterior part of the last whorl, just behind and parallel to the labrum, exhibits a longitudinal swelling or varix, towards which the lip expands'' (*Smith*).

I have not seen *Pupa solitaria*, which on account of its remote locality, may prove to have some special characters. The figure shows a more ovate contour than *B. barbadensis*, but with no other differences from that shell. I strongly suspect that, like the three species of *Opeas* on the same island, a comparison of specimens will show that it is not separable from the Antillean species. Both *Opeas* and *Gastrocopta* might easily be introduced. Provisionally it may be ranked as a subspecies.

25. GASTROCOPTA POLYPTYX n. sp. Pl. 17, figs. 5, 6, 7.

The parietal and angular lamellæ are more separated than in *barbadensis*. *There is a distinct infraparietal nodule.* The horizontal columellar lamella turns upward at its inner end, and there is a well-developed subcolumellar nodule. The upper palatal plica is rather large and runs obliquely downwards; lower palatal long and deeply placed. Basal fold thicker than in *barbadensis*, and prominent. The color is from corneous to pale brown.

Length 1.8, diam. above aperture 0.8 mm.

Length 1.7, diam. above aperture 0.75 mm.

Distribution. — St. Thomas (type loc.); Jamaica (A. D. Brown coll.); Bermuda (Swift coll., from C. B. Adams).

This appears to be a species of the *barbadensis* stock in which the apertural lamellæ are very strongly developed and the average size smaller. The specimens seen from Jamaica and Bermuda are not from original collectors, and the species has not turned up in the very large amount of material collected in these islands in recent years.

II. SOUTH AMERICAN SPECIES OF GASTROCOPTA.

Few *Pupillidæ* are known from South America, most of them belonging to *Gastrocopta*. The two subgenera represented occur also in North America, and the species are closely

related to Antillean and continental North American forms. Some species (*oblonga, miliola, clessini*) are deficient in teeth, like the northern *parvidens* and *riisei*.

For other South-American Pupæ, see the genera *Gibbulina, Bothriopupa, Sterkia* and *Pupoides*. *Pupa plusiodonta* appears from the description to be an *Abida* (*Torquilla*), and I venture to suggest that the single specimen is really a European shell, which got among Argentine shells by accident.

No useful key to species can be constructed, as several species are quite imperfectly known. They may be arranged as follows:

I. Angular and parietal lamellæ united into a single sinuous lamella, sometimes bifid at the tip (subgenus *Gastrocopta*, restricted).

24*b*. *G. barbadensis solitaria* (Smith). Fernando Noronha, p. 88.

26. *G. servilis oblonga* (Pfr.). Amazon River to Argentina.

27. *G. miliola* (Orb.). Rio Janeiro, eastern Bolivia.

28. *G. microdonta* (Doering). Argentina.

29. *G. clessini* (Doering). Argentina.

30. *G. nodosaria* (Orb.). Eastern Bolivia.

31. *G. wolfi* (Miller). Western Ecuador.

32. *G. munita* (Reibisch). Galapagos.

33. *G. clausa* (Reibisch). Galapagos.

II. Angular and parietal lamellæ diverging forward, becoming separate in front (subgenus *Immersidens*).

34. *G. dicrodonta* (Doering). Argentina.

35. *G. iheringi* (Suter). Southern Brazil.

36. *G. pazi* (Hidalgo). Peruvian Andes (? Ecuador, ? Panama).

III. Characters uncertain.

37. *Pupa curta* Anton. Chili.

26. GASTROCOPTA SERVILIS OBLONGA (Pfeiffer). Pl. 17, figs. 9, 14, 15.

The shell is subperforate, oblong, thin, nearly smooth, little shining, pellucid, corneous-buff, gradually tapering upwards,

the apex rather obtuse. Whorls 5½, convex, the last scarcely one-third the length, rounded basally. Columella obsoletely folded. Aperture oblique, truncate-oval; parietal wall having one tooth-like fold; peristome thin, the right margin strongly curved above, a little expanding; columellar somewhat dilated, spreading. Length 2⅔, diam. 1⅓ mm. (*Pfr.*, 1853).

Aperture in perfect specimens five-toothed: one compressed parietal, one columellar, three palatals, of which the middle one is distinct, the others obsolete (*Pfr.*, 1859).

Habitat unknown (Mus. Cuming and Pfeiffer). ? Bahia, Brazil. Uruguay: Santa Lucia near Montevideo (Paz, in Hidalgo). Argentina: a *barranca* on the bank of the Parana, near Rosario; Sierra de Pocho at Cerro Salado; and Sierra S. Luis, Valle de Cautana (Doering).

Pupa oblonga Pfr., Monographia Hel. Viv., iii, 1853, p. 536; iv, 685; vi, 332; viii, 403; Proc. Zool. Soc. Lond., 1852, p. 69 (1854).—Kuester, Syst. Conchyl. Cab., p. 173, pl. 21, f. 1, 2.—Hidalgo, Viaje al Pacifico, Moluscos, p. 141.—Doering, Boletin Acad. Nac. Ciencias de la Rep. Argentina, iii, 1879, p. 81.

The figure of Kuester copied in pl. 17, fig. 9, does not show the upper and lower lip-teeth, which Hidalgo remarks are noticeable in adult examples.

Doering copied Hidalgo's description, adding the remarks that it differs from *P. microdonta* by the larger and somewhat cylindric shape, and that it seems to be rather widely spread in Argentine territory.

I have seen numerous specimens from eastern Brazil: Para (Dr. Hubbard, A. N. S.; J. B. Steere, U. S. N. M.; and others); coast of Ceara (Fred Baker, A. N. S. P.); Fortaleza, Ceara (von Ihering, in U. S. N. M.); Brazil (labeled *P. oblonga*, apparently in the hand of Paz, U. S. N. M.). They vary from light brown to a faintly brownish corneous, and differ from typical *G. servilis* by often (but not always) having the basal fold very small or even wanting, as well as by the usually paler color and the slightly fuller outlines of the spire. Two examples measure:

Length 2.35, diam. above aperture 1.15 mm. (fig. 14, Fortaleza).

Length 2.1, diam. above aperture 1.1 mm. (fig. 15, Para).

It does not seem to me specifically distinct from *G. servilis*. By the weakness of the teeth it resembles *G. s. riisei*, which was evidently derived from *servilis*.

27. GASTROCOPTA MILIOLA (Orbigny).

Shell oblong, short, perceptibly umbilicate, quite thick, smooth; spire short, swollen, with the summit very obtuse as though truncate, composed of 5 swollen whorls separated by a deep suture. Aperture rounded, provided with three teeth, one on the parietal wall, the two others smaller, on the left margin. Color whitish or fawn. Length 2, width 1 mm.

Brazil: environs of Rio de Janeiro, under dead leaves. Bolivia: province of Santa Cruz de la Sierra, in the last mountains.

Helix miliola ORB., Mag. de Zool., 1835, p. 17.—*Pupa miliola* ORB., Voyage dans l'Amér. Mérid., p. 323. — DOERING, Boletin Acad. Nac. Ciencias de la Rep. Argentina, iii, 1879, p. 84.

According to Orbigny, this species is shorter than *paredesii* and *nodosaria*, with nearly the same form. It has not been figured.

Doering has identified a species from the Sierra de Cordoba, in shady, humid places in the valleys of the Rio Primero, Rio Ceballos, etc., with Orbigny's species. He describes it as having parietal and columellar lamellæ and a deeply-placed lower palatal fold.

Rio Janeiro may be selected as the type locality. Until specimens from there can be examined, the characters of the species will remain uncertain.

28. GASTROCOPTA MICRODONTA (Doering).

"Shell ovate-conic, thin, somewhat glossy, nearly smooth, brownish-corneous. Spire conic-ovate, apex tapering, very obtuse. Whorls 5½, a little convex, the last about one-third the length. Aperture semioval, five-toothed: one compressed,

lengthened, obliquely truncate fold on the parietal wall; one on the columella; a third small basal one; fourth tooth distinct, in the middle of the right margin; the fifth smallest, obsolete, in the upper margin. Peristome thin, narrowly expanding throughout, the right strongly curved above, columellar margin somewhat dilated. Length 2, diam. 1 to 1.2 mm.

"Differs from *P. oblonga* by the shorter, ovate shell, with the whorls but little convex, the parietal tooth protracted and truncate, etc." (*Doering*).

Argentina: Province of Entre-Rios, around La Paz, and in Corrientes, in the woods along the Rio Guayquirazo, living under decaying tree trunks; also Bajo de Vélis, in the Sierra de San Luis (*Doering*).

P.[*upa*] *microdonta* Doering, Apuntes sobre la fauna de moluscos de la Republica Argentina, pt. 4, in Boletin de la Academia Nacional de Ciencias de la Rep. Argentina, iii, 1879, p. 82.—Nachrichtsblatt d. deutschen Malak. Ges., 1880, p. 84.

In the Nachrichtsblatt for 1880 it was said to be identical with *Pupa pazi* Hidalgo, probably on Doering's authority. The description indicates rather a species similar to *G. servilis*, but of smaller size, close to *G. pellucida*.

29. Gastrocopta clessini (Doering).

"Shell subperforate, minute, oblong, cylindrically conic, thin, delicately striatulate, a little shining, buff-corneous. Spire long, slender, conic-cylindric, the apex rather obtuse. Whorls 5 to 6, very convex, gradually increasing, the first hyaline-corneous, smooth, the rest buff-corneous. Suture deep, wide. Aperture truncate, semioval, three-toothed: one compressed, pliciform tooth in the parietal wall; the second tongue-shaped, on the columella; the third deep in the palatal wall. Peristome white, thin, expanded throughout, a little reflected. Length 2 to 2.2, width 0.8 to 0.9 mm.; aperture 0.7 mm. long, 0.6 wide" (*Doering*).

Argentina: abundant in suitable places in the Sierra de Cordoba, as, for example, the valley of the Rio Primero, Rio

Ceballos, Quebrada de Musi, etc.; also Bajo de Vélis, in the Sierra de S. Luis (Doering).

P.[upa] clessini Doering, Apuntes, etc., in Boletin de la Academia Nacional de Ciencias de la Rep. Argentina, iii, 1879, p. 83.

"It is very easy to distinguish this little species from the others by its delicacy, the cylindrically conic shape, the pronounced convexity of the whorls, and by the depth of the suture. The striæ of growth are usually quite conspicuous."

It seems from the above account to resemble *G. nodosaria.*

30. Gastrocopta nodosaria (Orbigny). Pl. 17, fig. 10.

The shell is pupoid, oblong, noticeably umbilicate, thin, smooth; spire cylindric with truncate summit, composed of six swollen whorls separated by a deep suture. Aperture oval, provided with a large, as though bidentate, lamella on the parietal wall. Margins noticeably reflected. Color uniform grayish-fawn. Length 2, width ⅔ mm. (*Orb.*).

Bolivia: at a place called Pampa Ruis, Province of La Laguna, in the last foothills of the eastern slope of the Andes; under stones and moss (Orbigny).

Helix nodosaria Orb., Mag. de Zool., 1835, p. 22.—*Pupa nodosaria* Orb., Voy. dans l'Amérique Méridionale, p. 322, pl. 41 *bis*, f. 12-14.

Orbigny adds that this Pupa has the shape of the preceding [*P. paredesii*], but it differs by the smaller size, the absense of raised riblets, and by having a lamella in the aperture. It is rare, and difficult to collect on account of its extreme thinness.

It may be conjectured that this is a member of the *G. pellucida* and *barbadensis* group, really having more teeth than it has been credited with.

31. Gastrocopta wolfii (Miller). Pl. 28, figs. 1, 2, 3, 4.

The shell is subperforate, cylindric-ovate, thin, very delicately obliquely striate or costulate, brownish, the apex rather obtuse; whorls 5, convex, separated by a deep suture, the last about one-third the length. Aperture suboblique, truncate-

oval, four- or five-toothed: first or strongest tooth is a twisted, bifid, vertical lamina which is arched to the right, and more deeply to the left, on the parietal wall; the second tooth is strong, on the columella; two teeth (the third and fourth) are deep in the right margin (the upper one small, the other in the middle, oblique, long and laminiform); the fifth tooth is deeply placed, small and sometimes wanting, placed in the base. Peristome simple, the right margin lightly impressed, almost horizontal above, basal and columellar broadly expanding, the margins joined by a callous. Length 2 to 2½, diam. 1¼, aperture 0.8 mm. long, 0.7 wide (*Miller*).

Ecuador: Guayaquil, in shady places, in gardens, especially on mossy stones, abundant (Theodor Wolf). Duran, near Guayaquil (Rhoads).

Pupa (subg. *Leucochila*) *wolfii* Miller, Malakozoologische Blätter (n. F.), i, 1879, p. 127, pl. 14, f. 3.—*Pupa wolfii* Miller, Reibisch, Abhandl. naturwiss. Ges. Isis in Dresden, 1892, p. 27, pl. 2, f. 11.

As described and figured by Miller (fig. 4), this species does not differ materially from *G. servilis;* but specimens from "Ecuador" (no. 307631, U. S. N. M.) and from Duran, opposite and near to Guayaquil (S. N. Rhoads, in A. N. S. P.), while agreeing with *wolfii* in all other respects, have an additional tooth, the infraparietal. This may have been overlooked by Wolf and Reibisch, or undeveloped in their specimens.

The shell (pl. 28, figs. 1, 2, Ecuador, and pl. 28, fig. 3, Duran) tapers noticeably and is light brown. The lip is well expanded and thin, without a crest (this feature differentiating it from *G. riograndensis*); lip-ends are not very widely separated. The angulo-parietal lamella is exactly as in *G. servilis*, there being a median lobe towards the periphery, representing the inner end of the angular lamella. The small infraparietal nodule is opposite the middle of the parietal lamella, being therefore rather deep within (fig. 2). Columellar lamella, basal and palatal plicæ as in *G. servilis.*

Length 2.55, diam. above aperture 1.05 mm.; 5¼ whorls.

Length 2.1, diam. above aperture 1 mm.; nearly 5 whorls.

This species is clearly distinct from *G. pazi*, and also from the species described from the Galapagos, though *G. munita* (Reibisch) approaches it. *G. riograndensis* differs by its well-developed crest behind the lip, *wolfii* having only the trace of a crest or none.

32. GASTROCOPTA MUNITA (Reibisch). Pl. 19, figs. 1 to 7, 8, 10, 11.

Shell deeply rimate, ovate-cylindric, with obtuse apex; thin, diaphanous, smooth, opaque, pale corneous or whitish. Suture moderately deep. Whorls 5 to 5⅓, convex. Aperture subvertical, rounded, calloused; a bituberculate entering fold on the parietal wall of the aperture, another simple, somewhat receding one on the columella, as well as 4 smaller denticles within the outer lip, which, however, are often lacking, excepting the one opposite the parietal lamella. The broad peristome is reflected and the margins are connected by a rounded callous. Length 2.5, diam. nearly 1.5 mm. Aperture 1 mm. long, nearly 1 wide (*Reibisch*).

Galapagos Islands: Albemarle, on shrubs near the seashore (*Wolf*); Tagus Cove on leaves of Croton, and near Iguana Cove at 2000 ft.; also Narborough Island (Snodgrass and Heller).

Pupa (*Leucochila*) *munita* REIBISCH, Abhandlungen der Naturw. Ges. Isis, in Dresden for 1892, p. 27, pl. 2, f. 9.—*Pupa wolfii* Miller, DALL, Proc. A. N. S. Phila., 1896, p. 446, pl. 17, f. 14; 1900, p. 94.—*Pupa pfeifferi* BOETTGER, Conchologische Mittheilungen, i, 1881, p. 68, pl. 12, f. 18. Not *Pupa pfeifferi* Krauss (prior to 1848).

"The species stands very near *Pupa wolfii* Miller, which is abundant in the province Guayaquil, Ecuador" (*Reibisch*).

This species differs constantly from *G. wolfii*, in a great number examined, by the *more convex outline of the spire*, which is wider in the upper part, and by the *much thickened or labiate peristome*. *G. wolfii* tapers more regularly, the individual whorls are more convex, and the peristome is thin. Other differences are that *munita* usually has a much stronger (though variable) crest behind the lip, and generally there is an interpalatal plica, which is lacking in *wolfii* so far as seen.

While Reibisch was probably correct in mentioning *wolfii* as the species most nearly related to *munita*, the thick lip is a feature recalling *rupicola, marginalba* and some forms of *barbadensis*.

Dr. W. H. Dall has discussed the tooth variations of this species (*loc. cit.*, p. 446), and has generously permitted me to examine the material in the National Museum. As in several other multidentate species of the genus, the infraparietal, interpalatal and basal teeth, and the subcolumellar callous, are variable in development, and some or all of them may be lacking in fully adult individuals.

The original figure is copied in pl. 19, fig. 7.

At Tagus Cove, Albemarle, which in the absence of definite information may be taken as type locality, the shell varies in color from a somewhat transparent cartridge-buff (pl. 19, figs. 1, 8) to cinnamon or tawny (fig. 3). Usually it is somewhat opaque, and the periostracum is often worn. Under a strong lens it appears minutely granulose, and is therefore not glossy. The angulo-parietal lamella is more or less bifid in front view, and seen from below the parietal projects slightly on the columellar side (pl. 19, fig. 2). The infraparietal tubercle is variable in size, as in other species having it. Often it is a mere rudiment, and very rarely it is absent in fully adult shells. The columellar lamella is stout, short and horizontal; often there is a buttress, sometimes somewhat tubercular, under its inner end, as in *rupicola* and some other species; and as in these, it is individually variable, and not due to age. The lower palatal plica is an entering lamina, as in related species. The upper palatal is well developed, tubercular. Basal plica smaller, tubercular or shortly entering. There is a small interpalatal plica, variable in size and exact position, and sometimes lacking.

Length 2.65, diam. 1.3 mm.

Length 2.45, diam. 1.1 mm.

Length 2.45, diam. 1.2 mm.

In another lot from Tagus Cove (Snodgrass) the extremes of size are 2.15 and 2.45 mm. long. Others, found on crotons, have no infraparietal lamella. Specimens found by Dr. G.

Baur on bones of turtles, in southern Albemarle, are 2.3 mm. long, 1.1 to 1.2 mm. diameter. The smallest seen from Albemarle (Iguana Cove) is 2.2 mm. long, others of the usual size occurring in the same lot; the colors being from cartridge-buff with white lip to tawny with cinnamon lip. One exceptionally simplified shell from this locality (pl. 19, fig. 10) has neither infraparietal or interpalatal teeth, and the basal fold is very minute. In most lots from Albemarle the shape varies from somewhat ovate to cylindric.

On Narborough Island (Snodgrass) the infrapalatal nodule is generally either very low or entirely wanting, an interpalatal plica is usually absent, and the basal fold is very small. The shape and thickened peristome remain typical (pl. 19, fig. 11). There appears, therefore, to be slight racial divergence, since the form prevalent on Narborough is quite rare among specimens seen from Albemarle.

On Charles Island only specimens of medium and small size have been found, length 2 to 2.4 mm. The crest behind the lip is wanting in many examples, and not strongly developed in others. The teeth vary as in Albemarle examples.

Tower Island has shells very similar to the narrower examples from Albemarle, and showing the same variations.

This species, which seems to be rather common on several islands of the Galapagos group, was first described by Professor Boettger as *Pupa pfeifferi*, said to be from Pitcairn Island, from specimens supplied by Mr. Cuming. Nothing similar to it has been found in Polynesia, and as Cuming collected extensively in the Galapagos, there can be little doubt that his locality was erroneous in this case, as in many others. The original description of *P. pfeifferi* and copies of the figures follow.

Pupa pfeifferi Boettg. Pl. 19, figs. 4, 5. Shell related to *P. pediculus*, but smaller, narrower, more oblong, pale *corneous-yellow*, not whitish-pellucid; whorls less convex. Aperture smaller, rotund-quadrate, six-toothed, the teeth less strong; one lamelliform angular, which is rather distinctly bifid in the middle; one columellar; four smaller receding palatals, which are punctiform except the larger third one.

Peristome little expanded, *labiate*. Length 2¼ to 2½, width 1 to 1⅛ mm.

Pitcairn Island, Tuamotu group (Dohrn–Pfeiffer coll., from H. Cuming).

Differing from all the species of the section *Leucochilus* known to me, with the exceptions of *P. marginalba* P. and *P. pellucida* P., the species under consideration has a horn-brownish color, and is so easily to be distinguished from the second Pacific species of this section by this, as well as by the shape of the shell, the more numerous palatal plicæ and the thickened rim of the small aperture, that the relegation of our form to *P. pediculus* as a variety cannot well be entertained.

That one of the two species from Pitcairn Island enumerated in Beck's Index, p. 85, is identical with our species appears very possible; yet as diagnoses of these nominal species do not exist, to my knowledge, I feel justified in proposing a new name for the species here described (*Boettger*).

33. GASTROCOPTA CLAUSA (Reibisch). Pl. 19, figs. 9, 12, 13, 14.

Shell deeply rimate, ovate-cylindric with obtuse summit, thin, smooth, matt, pale corneous or whitish. Suture rather deep. 4⅔ convex whorls. Aperture nearly vertical, round, narrowed by numerous teeth. The bipartite parietal tooth runs deeply into the throat, also the columellar tooth; in the outer wall there are two small denticles, sometimes wanting, on each side of the strongly developed middle tooth (which stands opposite the parietal tooth). The peristome expands but little and is hardly reflected, the ends joined by a rounded callous. Length 2.2, diam. 1.25 mm. Aperture 0.9 mm. long, 0.8 wide (*Reibisch*).

Galapagos Islands: Indefatigable, on shrubs near the seashore (*Wolf*). Abingdon, at sea level (*Snodgrass*).

Pupa (*Leucochila*) *clausa* REIBISCH, Abhandlungen der Naturw. Ges. Isis, 1892, p. 27, pl. 2, f. 10 (1893).—*Pupa clausa* Reibisch, DALL, Proc. A. N. S. Phila., 1900, p. 94.

This species is a further evolution product of *Pupa wolfii* Mill., to which *P. munita* of Albemarle Island forms a transition (*Reibisch*).

The specimens from Abingdon (pl. 19, figs. 12–14) agree with the typical description and figure (fig. 9). The last two whorls are rather weakly convex. There seems to be little if any crest behind the lip, which expands narrowly. The angular and parietal lamellæ are well separated, much as in *G. bilamellata*, and more than in any nearly related species; but the inner end of the parietal does not curve towards the periphery, as in the *Immersidens* group. The infraparietal lamella is laminiform and runs inward parallel to the parietal. Columellar lamella is very strong and the callous below it is built up into a subcolumellar lamella. The lower palatal plica enters deeply. Upper palatal plica is strong but shorter. A thin interpalatal stands between them. Basal plica well developed, entering. The peristome, as in *G. munita*, is strongly labiate or calloused within except at the sinulus.

Length 2.1, diam. 0.9 mm.

Length 2.2, diam. 1 mm.

While related to *G. munita*, this is an extremely distinct species, recalling the West-Indian *G. polyptyx* and the Bonin Island species.

Subgenus IMMERSIDENS Pils.

34. GASTROCOPTA DICRODONTA (Doering).

"Shell minute, pupoid, smooth, substriatulate, a little shining, brownish-corneous. Spire subconic, the summit tapering, rather obtuse. Whorls 5½ to 6, a little convex, the last about two-fifths the length. Aperture oval-rounded, contracted by 5 (–6) teeth: the first, on the parietal wall, largest, twisted, bifid (forked or biramose), the right branch produced to the margin of the peristome, the other remote from the margin of the aperture; second tooth columellar, tortuous, angulate, lengthened within; three pliciform palatal teeth. Peristome expanded, scarcely reflected, whitish, the margins nearly connected, right margin curved. Length 1.8 to 2, width 0.9 mm.; aperture 0.7 to 0.8 mm. long" (*Doering*).

Argentina: around Villa Vicencio in the Sierra de Mendoza; all suitable places in the sierras of Cordoba and San Luis (Dr. Stelzner).

P.[upa] dicrodonta DOERING, Apuntes, etc., in Boletin de la Acad. Nac. de Ciencias de la Rep. Argentina, iii, 1879, p. 83.

"This species may be distinguished easily from all the rest by the bifid tooth on the parietal wall of the aperture. It is composed of two parallel ridges, the superior one being prolonged upward to the position of the insertion of the lip, the other one having a more immersed place, behind the first. The rest of the teeth of the aperture are of smaller size. This species is doubtless the most abundant in the territory of the sierra of Cordoba, etc." (*Doering*).

35. GASTROCOPTA IHERINGI (Suter). Pl. 17, fig. 16.

The shell is minutely perforate and rimate, convexly tapering above, the last two whorls nearly equal in diameter. There are 5⅓ moderately convex whorls, the last one without crest. Apex obtuse. Surface minutely, unevenly striate. The aperture is very shortly oval. Peristome thin, expanded throughout, interrupted above. The angular and parietal lamellæ are nearly parallel and of about equal length; the angular is sigmoid, its inner end curving towards and joining the parietal. Parietal lamella nearly straight, highest where the angular joins it. Columellar lamella large, semicircular, its anterior part running forward, inner part curving downward parallel to the axis. The upper and lower palatal plicæ are short, high, entering laminæ. Basal fold is large, straight-topped, and nearly radial, transverse to the cavity. Length 2.3, diam. above aperture 1.1 mm.

Brazil: Bollaxa, City of Rio Grande do Sul, subfossil in a modern deposit (H. von Ihering).

Pupa iheringi SUTER, Revista do Museu Paulista, iv, 1900, p. 336, pl. 3, f. 8, 8*a*.

The armature of the aperture is more like that of *G. bilamellata* than any other of our northern species, the differences being merely in small details of form, except that the lower palatal plica is more deeply immersed in *bilamellata*. Figured and described from paratypes. This species is very closely related to *G. dicrodonta*, perhaps identical; yet the latter is slightly smaller, with a fraction of a whorl more, and comes

from a more elevated region, rather different faunally. Pending a direct comparison, both may be allowed to stand.

36. GASTROCOPTA PAZI (Hidalgo). Pl. 17, fig. 13.

The shell is rimate-subperforate, ovate-cylindric, thin, very lightly striatulate, corneous; spire with the apex obtuse; suture deep; whorls 5 to 5½, convex, the last about one-third the entire length, ascending a little in front, the base obtusely angular around the umbilical crevice. Aperture is vertical, truncate-oval, six-toothed: one transverse columellar; two folds (one angular, and one more deeply placed parietal), distinct or joined at the base, and appearing like a bifid tooth; three teeth in the right margin, situated deeply, the middle one larger. Peristome equally expanded, the right margin strongly curved above; columellar margin dilated. Length 2.5, diam. 1 mm. (*Hidalgo*).

Peru: Amancaez, in the environs of Lima (type locality). Ecuador: Guayaquil. Panama (Paz).

Pupa pazi HID., Journal de Conchyl., 1869, p. 412; 1870, p. 66; 1875, p. 129, pl. 7, f. 7.—PFR., Monogr. Hel. Viv., viii, p. 402.

This species was well described, but the figures are worthless. In a subsequent notice Hidalgo states that the specimens from the last two localities are those (alluded to in the description) in which the angular and parietal lamellæ are united at their bases. I select the Amancaez specimens as types. Perhaps those from the other localities are specifically distinct. I have not seen South-American specimens, but some Panama shells received from Sr. Paz under this name prove to be typical *G. servilis*. *G. pazi*, from the description, must be very close to *G. prototypus*, but differs by having a basal fold. Until types or topotypes can be examined, its exact relation to other species remains uncertain.

Examples from the city of Guatemala, described as *G. prototypus basidentata*, agree rather well with the description of *G. pazi*, and may possibly be referable to that species.

(*Position uncertain.*)

37. *Pupa curta* Anton. Shortly cylindric; 4½ whorls, with deep suture; finely striate; epidermis brown; narrowly umbilicate; aperture somewhat compressed (as in *pagodula*), with three lamelliform denticles. Breadth ½, height 1 line (*Anton*).

Chili (Anton).

Pupa curta ANTON, Verzeichniss der Conchylien welche sich in der Sammlung von Hermann Eduard Anton befinden, 1839, p. 47, no. 1731.—PFR., Monographia, ii, p. 355.—*Alæa annaaensis* BECK, Index Moll., 1837, p. 85 (I. Annaa; no description).—Not *Pupa curta* Potiez et Michaud, 1838.

Nothing has been added to Anton's description of this species, which may be a *Gastrocopta*. In a letter to Pfeiffer he stated that it was identical with the above-mentioned species of Beck, of which only the name and locality were recorded. The name *P. curta* had been used in 1838, but it is not worth while to re-name a poorly defined species, not localized, and impossible to recognize.

III. SPECIES OF EASTERN ASIA, FROM JAPAN TO FRENCH INDO-CHINA.

This geographic division includes also the Bonin and Loochoo Islands. It is characterized by the prevalence of Gastrocoptas of the series of *G. armigerella*, no other group being known as yet. It is to be expected that China will eventually add many species.

Subgenus SINALBINULA Pilsbry.

See p. 11. Most Sinalbinulas have the mouth parts rather more coarsely granular than in other gastrocopts. The exterior also is usually minutely granular, a character also common to many species throughout the genus.

Sinalbinula is widely distributed in eastern and southern Asia, south to Australia, in Polynesia, Micronesia and Hawaii. Westward there are single species in the Trans-Caucasus region (no. 64) and Abyssinia (no. 65), these being survivors

of the early Oligocene migration westward, when the group flourished in Europe from Middle Oligocene to Pliocene. *Sinalbinula* is more widely distributed than any other subordinate group of the genus.

The Asiatic mainland and European Pliocene species are the most progressive, some having the angulo-parietal lamella thoroughly unified, as in typical *Gastrocopta*. In America no species are referable to *Sinalbinula* proper, but the section *Vertigopsis* is evidently a derivative group, differentiated chiefly by the degeneration of both the angular and parietal lamellae, the former being either wholly lost, or in some forms still present but very minute.

The Bonin Island group remains primitive in the separation of angular and parietal lamellae, leading us to believe that they have been isolated a very long time.

The Australian *Sinalbinulas* are more primitive than the Asiatic continental forms. The angular and parietal lamellae are imperfectly connected, and the columellar lamella is horizontal and short, or the inner end is but slightly curved down. The palatal callous is thin but noticeable in species I have seen. They are in about the same stage of evolution as the isolated Bonin Island recent species, and those of the European Oligocene, though rather different by the strongly converging instead of subparallel angular and parietal lamellae.

Key to Eastern Asiatic Species.

a. Three subequal and parallel lamellae on the parietal wall; Bonin Is.

b. Length about 2.4 mm. *G. chichijimana*, no. 38.

b^1. Length about 1.75 mm. *G. c. ogasawarana*, no. 38*a*.

a^1. Angular and parietal lamellae closely juxtaposed and united by a callous, but not continuous.

b. Parietal lamella nearly behind the angular; an infraparietal lamella shorter than the parietal; Bonin Is. *G. boninensis*, no. 39.

b^1. Angular and parietal lamellae juxtaposed laterally; no infraparietal lamella or tubercle; Indo-China. *G. ejecta*, no. 45.

a^2. Angular and parietal lamellae united into a continuous, bilobed lamella.

b. 4 teeth: angulo-parietal, columellar, upper and lower palatal; 2¼ mm. long; Macao, Hongkong.

G. meridionalis, no. 44.

b^1. 6 or 7 teeth.

c. Angulo-parietal lamella arcuate in basal view, its inner end curving towards columella; infraparietal pliciform; Pe-chili.

G. hirasei, no. 42.

c^1. Angulo-parietal lamella approximately straight in a basal view.

d. Inner end of columellar lamella bent down; a tubercular infraparietal lamella usually present.

e. Length 2.25 to 2.5 mm.; Japan, China. *G. armigerella*, no. 40.

e^1. Length 2 mm.; more broadly ovate; Hachijo I.

G. a. hachijoensis, no. 40*a*.

d^1. Columellar lamella short and straight, horizontal; no infraparietal lamella or tubercle.

e. Length about 2 mm.; Korea.

G. coreana, no. 41.

e^1. Length about 1.5 mm.; Sytchuan.

G. monadicula, no. 43.

38. GASTROCOPTA CHICHIJIMANA n. sp. Pl. 20, figs. 1, 2.

The shell is rimate, ovate-conic, pale olive-buff (dotted with white by disintegration of the cuticle in the specimens seen), almost smooth but hardly shining, composed of 5⅓ rather strongly convex whorls, the last one flattened over the lower palatal region, having a strong, wide and rounded crest behind the lip. Aperture having 8 teeth, of which three, subequal, are on the parietal wall; the angular lamella is weakly connected with the parietal by a low callous at its inner end; parietal lamella more deeply placed, its anterior end about as

far forward as the middle of the angular lamella; infraparietal lamella long, not quite so deeply placed as the parietal. Columellar lamella strong, horizontal throughout. The palatal and basal plicae stand on a strong callous ridge, the lower palatal being largest, suprapalatal and basal smaller. In the type lot there are one or two minute infrapalatal denticles, between lower palatal and basal. The lip is thin, a little expanded, the outer margin somewhat bent in, in the middle, and very strongly arched above. The adnate part of the peristome is very short. Length 2.4, diam. above aperture 1.35 mm.

Chichijima, Ogasawara (Bonin) islands (Hirase). Type and cotpyes No. 83897 A. N. S. P.

Peculiar for the nearly equal length of the three lamellae of the parietal wall, which stand parallel, the angular and parietal being only weakly connected.

The teeth in the base are variable, some individuals having two denticles between lower palatal and basal, some one, and one example none. The basal and infrapalatal folds are sometimes subequal.

The crest behind the lip is variable, as in American Gastrocoptas of the *pentodon* group. Usually it is strongly developed, but in one example it is reduced to a very low, broad wave. A small individual measures, length 2.25, diam. 1.3 mm., 5 whorls.

Under a high power, the surface is seen to be densely, irregularly granulose throughout.

38*a*. *G. c. ogasawarana* n. subsp. Pl. 20, figs. 3, 6.

The shell is smaller than *chichijimana*, with the angular and parietal lamellae less widely separated; basal fold stout, well-developed; no minor folds between it and the lower palatal plica. Aperture of a more triangular shape, the external crest and the internal palatal callous strongly developed. Length 1.75, diam. 0.96 mm.

Ogasawara (Bonin) islands: Chichijima, type loc.; Ototoshima (Hirase).

Some specimens are intermediate in size between this form and typical *chichijimana*; otherwise it would be thought specifically distinct.

39. GASTROCOPTA BONINENSIS n. sp. Pl. 20, figs. 4, 5.

The shell is rimate, oblong-conic, composed of 5 rather strongly convex whorls, very pale buff, the summit gray. Surface scarcely shining, very minutely and densely, irregularly granulose, but scarcely showing a trace of striae. Last whorl flattened over the lower palatal region, having a high crest behind the lip. Angular lamella curving towards the right, its inner end joined to the anterior end of the parietal lamella by a low callous. Parietal lamella nearly behind the angular. The infraparietal lamella is decidedly shorter than the parietal. Columellar lamella strong, horizontal. Four plicae stand upon the strong palatal callous, the lower palatal longest, the upper palatal, basal and suprapalatal being successively smaller. Lip thin, a little expanded. Length 2.17, diam. 1.07 mm.

Ogasawara (Bonin) islands: Minamijima, type loc.; Chichijima (Hirase).

The angular and parietal lamellae are far more closely united than in *G. chichijimana*, and the infraparietal lamella is shorter. It differs from *G. armigerella* by the lamelliform infraparietal and the less united angular and parietal lamellae. The microscopic granulation is coarser in *boninensis* and *chichijimana* than in *armigerella*.

40. GASTROCOPTA ARMIGERELLA (Reinhardt). Pl. 20, figs. 7 to 11.

Shell dextral, conic-ovate, rimate, whitish, pellucid, a little shining, smooth. Whorls 5, cylindric, parted by a deep suture, the last a little compressed at base. Aperture rounded-triangular, 7-toothed: two teeth on the parietal wall, one placed in front of the insertion of the outer lip, the other near the columella, smaller, nodule-like and deeply placed; columella bidentate, the upper tooth stronger; three palatal teeth, the uppermost smallest, the lower one large; they are joined by a callous which is visible externally. Peristome subcontinuous, simple, a little expanded, the right margin inclined above towards the dilated columella. Length 2¼, width 1 mm. (*Reinhardt*).

Japan: Misaki, Sagami (type loc., Hilgendorf); Miyakejima, Izu; Chichi-jima, Ogasawara (Bonin) Islands; Yoronjima, Okinoerabu-shima, Kume-jima, Kunchan, Yaeyama, in the Luchu arc (Hirase). Korea: Soeul and Hatong (Dr. Gottsche). China: Dshi-nan-fu, Prov. Shan-dung (Möltner); Shanghai (Heude, Schmacker); Ning-kuo-fu, Prov. An-hui (Heude, for *P. monas*); Prov. Hunan (Fuchs); Dshie-dshow and Tshing-yuan, Prov. Gansu (v. Mlldff.)

Pupa (*Leucochila?*) *armigerella* Reinhardt, Sitzungsber. Ges. Nat. Freunde Berlin, 1877, p. 96; Jahrbucher D. Malak. Ges., iv, 1877, p. 323, pl. 11, f. 7.—Kobelt, Fauna Japonica, p. 62, pl. 1, f. 17.—*Pupa* (*Leucochilus*) *armigerella* Reinh., Moellendorff, Jahrb. D. M. Ges. xi, 1884, p. 178; xiv, 1887, p. 17.—Gredler, Mal. Bl. (n. F.), ix, p. 145.—*Leucochilus armigerellum* Reinh., Mlldff., Annuaire du Mus. Zool. de l'Acad. Imp. des Sci. de St.-Pétersb. vi, 1902, p. 85.—*Pupa atoma* Heude, Notes sur les Moll. Terr. de la Vallée du Fleuve Bleu, i, p. 77, pl. 18, f. 19 (quoted as "*Pupa extrema* Heude" by Moellendorf, *l. c.*, p. 85).—*Pupa monas* Heude, *t. c.* p. 78, pl. 18, f. 18. Not *P. monas* Morelet 1879.—*Bifidaria armigerella* var. *luchuana* Pilsbry, Proc. A. N. S. Phila. 1901, p. 484, pl. 24, f. 54 (Kunchan, Okinawa).

G. armigerella is intermediate between *G. coreana* and *G. hirasei*, the first having simpler, the last more developed apertural teeth.

The parietal lamella is higher than the angular, and its anterior end is completely concrescent with the latter, not projecting on the columellar side, as in many American species. The tooth as a whole is bilobed, being lower at the junction of the two elements (fig. 11). The infraparietal is tubercular. The columellar lamella is bent into a semicircular shape, the inner end being turning down vertically, the outer end horizontal (fig. 10). The basal fold stands at the junction of the basal and columellar margins, rather more upon the columellar, as in *Vertigopsis*. The lower palatal plica is a little lengthened, the others short. The size varies somewhat.

Length 2.5, diam. above aperture 1.2 mm. (Miyakejima, Izu).

Length 2.25, diam. above aperture 1.15 mm. (Miyakejima). Length 2.4, diam above aperture 1.15 mm. (Shanghai, China).

The synonymy has been worked out by Dr. von Moellendorff, and I have verified his results by the examination of large series of specimens from Heude, Hirase and Schmacker. *Pupa monas* Heude found on stone walls and rocks in the mountains south of Ning-kuo-fu, is almost typical *armigerella*, rather small and cylindric—the type was 2 mm. long.

Pupa atoma, Heude, found "very common under dead leaves of bamboos in the environs of Shanghai" was 2½ mm. long, and figured without an infraparietal nodule; but in a Shanghai lot from Heude and others from Schmacker, the nodule is present, though sometimes quite small and readily overlooked. According to von Moellendorf, *atoma* has no specific characters. Pl. 20, fig. 8 is a Shanghai specimen of *atoma* received from Heude. The form I described as *Bifidaria armigerella* var. *luchuana* from Kunchan, Okinawa, is typical *armigerella*; I had compared it with shells wanting the infraparietal nodule. One of this lot is sinistral.

40*a*. *G. a. hachijoensis* n. subsp. Pl. 21, fig. 1.

The shell is much stouter in figure than *armigerella*, ovate-conic.

Length 2, diam. 1.23 mm.

Japan: Hachijo-jima, an island of Izu (Hirase); type and paratypes No. 83395 A. N. S. P.

41. GASTROCOPTA COREANA n. sp. Pl. 21, figs. 2, 3, 4.

The shell is subcylindric but tapering slightly from the last whorl, the upper two whorls forming a convexly conic summit; whitish-corneous, quite lightly striate. Whorls 5, rather strongly convex, the last flattened over the lower palatal region, and with a narrow, rather low crest behind the narrowly expanded lip. Angulo-parietal lamella as in *B. armigerella*, being straight, the angular forming a spur on the right side, and lower than the parietal. There is no infraparietal nodule. Columellar lamella strong, short, horizontal, its inner end not

curving downward. Basal and palatal plicæ as in *G. armigerella*, the lower palatal being longer than the upper, suprapalatal and basal smaller than either. Length 2.05, diam. 1 mm.

Korea: Kojeto (Hirase). Type and paratypes No. 95775 A. N. S. P.

This species differs from *G. armigerella* by having the columellar lamella short and straight, wholly horizontal, the inner end not bent down, and by the absence of an infraparietal nodule.

42. GASTROCOPTA HIRASEI n. sp. Pl. 21, figs. 5, 6, 7, 10.

The shell is tapering-cylindric, shaped like *B. armigerella*, whitish-corneous, very slightly striate, composed of 5 rather strongly convex whorls, the last one flattened over the lower palatal region, slightly grooved over the lower palatal plica. Angulo-parietal lamella arcuate in a basal view (pl. 21, fig. 7), the *inner end curving towards the columella.* It is low in the middle, at the junction of angular and parietal elements, the angular and inner end of parietal being high. Infraparietal lamella pliciform, well developed. Columellar lamella horizontal in front, but inward forming a broad, downward-turned plate. There is also a convex hyaline callous ascending the axis, within the back (pl. 21, fig. 6). Basal fold subcolumellar in position, subvertical. Palatal plicæ strong, the lower one long; suprapalatal minute. Peristome thin, well expanded. Length 2, diam. 0.95 mm.

China: Shan-hai, Province Pe-chili (Hirase).

This species has all the apertural processes more developed than *G. armigerella*, the parietal lamella being bent inward, the infraparietal in form of a short lamella instead of a nodule, and the columellar lamella expanding in a broad plate.

A single specimen collected with *G. coreana* at Kojeto, Korea, has the bent parietal and broad columellar lamella of *hirasei*, though a little less strongly developed, but the infraparietal is tubercular, as in *armigerella*. It measures, length 2.28, diam. 1.1 mm. It will probably prove to represent a Korean subspecies.

43. Gastrocopta monadicula (Heude). Pl. 21, figs. 8, 9.

Shell small, spire ovate, whorls 5, rather inflated, joined by an impressed suture; aperture semielliptical, denticulate; peristome continuous, basal and external margin three-toothed; one tooth on the columella, one at the sinus on the parietal wall; an oblique rima. Length 1½, diam. ½ mm. (*Heude*).

China: Tchen-k'eou, Province Sytchuan.

Pupa monadicula Heude, Notes Moll. Terr. Fl. Bleu, p. 152, pl. 35, f. 24.

This species is much smaller than *G. armigerella*. Heude's figures are copied, as I have not seen the species.

44. Gastrocopta meridionalis (Moellendorff).

Shell dextral, conic-ovate, whitish, pellucid, a little shining, smooth; whorls 5, cylindric, parted by a deep suture, the last a little compressed basally. Aperture rounded-triangular, 4-toothed: one lamelliform tooth on the parietal wall, bifid anteriorly; another rather strong tooth on the columella, and two palatals. Peristome simple, a little expanded, the margins approaching. Length 2¼, diam. 1¼ mm. (*Mlldff.*)

China: village of Sha-ming, near Macao (R. Hungerford); Hongkong.

Pupa (*Leucochilus*) *meridionalis* Mlldff., Nachr. D. M. Ges. xvi, 1884, p. 28; Jahrb. D. M. Ges. xi, 1884, p. 179.—*Leucochilus meridionale* Mlldff., Binnen-Mollusken aus Westchina u. Centralasien, ii, 1902, p. 85.

Described from one imperfect shell collected in an old churchyard. According to von Moellendorff it is close to *G. armigerella*, but well distinguished by the smaller number of teeth.

45. Gastrocopta ejecta (Bavay & Dautzenberg). Pl. 21, fig. 12.

Shell small, thin and pellucid, dolioliform, tapering towards the apex, narrowly perforate. Whorls 5, convex, gradate, regularly increasing, joined by a conspicuous and narrowly margined suture, and obliquely, very delicately plicate, the

plicæ visible with difficulty even under the lens. Aperture almost circular, somewhat biangular above, rounded below; peristome continuous, somewhat spreading, very little thickened. Throat 4-toothed: palatal [= parietal] tooth strong and doubled, the inner part larger, pliciform, the outer smaller, less entering; columellar tooth horizontal; parietal [= palatal] teeth two, oblique, the lower one larger. A very small tooth in the lower angle of the columella, sometimes a little larger. Color white, hyaline. Alt. 2½, diam. maj. 1½, diam. aperture ⅘ mm. (*B. & D.*)

Indo-China: shore and islands of the Bay of Along (M. Demange).

Pupa (*Bifidaria*) *ejecta* Bavay et Dautzenberg, Journal de Conchyl. lx, 1912, p. 29, pl. 1, f. 16, 17.

This species stands very near to *Gastrocopta armigerella* Reinh., but differs, according to MM. Bavay and Dautzenberg, by wanting an infraparietal tooth, and by the form of the angular and parietal lamellæ, which are juxtaposed laterally, not superposed as in *armigerella*. It was found in the marine shell sand in company with *Diplommatina, Georissa, Kaliella,* all little land shells living among rocks, and evidently washed down to the sea.

IV. Species of western Siberia, Trans-Caucasus and the European Tertiary.

Gastrocopta appeared in Europe in the middle Oligocene. The subgenus *Albinula* is represented by the series of *G. quadriplicata,* which in various mutations continued to the Upper Pliocene (*G. fossanensis,* Piedmont).

The subgenus *Sinalbinula* began with species of the *G. didymodonta* series in the Upper Oligocene, became extinct in Europe at the close of the Miocene, but still survives in the recent Trans-Caucasian *G. theeli.* The series of *G. nouletiana,* in several successive slight mutations, existed through the Miocene.

The fate of *Gastrocopta* in Europe was determined, we may suppose, by the lowering of temperature which closed the Pliocene; but it should also be noted that the stock was appar-

ently rather inflexible, and competitors of the same family were more numerous, perhaps, than in any other part of the world.

The first European Gastrocoptas were described by Dupuy in 1850. Shortly after, Al. Braun described the leading German species, in Walchner's *Geognosie*, 2d edition. In the copy of this work at hand, as well as in two others on which bibliographic data are available, there are but 1120 pages; beginning Braun's contribution, but not containing the Pupae; so that I have copied references from Sandberger. The date of the later pages is uncertain. Sandberger, in Die Conchylien des Mainzer Tertiärbeckens, 1863, and Die Land- und Süsswasser-Conchylien der Vorwelt, 1870-1875, and especially Dr. Oskar Boettger in his admirable paper, Die Entwickelung der Pupa-Arten des Mittelrheingebietes in Zeit und Raum, in Jahrb. Nassauischen Vereins Naturkunde, 1889, are the chief authorities; but references to numerous other authors will be found below. Perhaps there are other described species; the plan of this work does not include a thorough review of palaeontological literature. Really adequate illustrations of European Tertiary species are still wanting.

Dr. O. Boettger classified the European Tertiary Gastrocoptas (*Leucochilus*) in three groups, noted below. Of these groups, that of *quadriplicata* was said by Sandberger to be related to the recent American *G. contracta*. Boettger considered *quadriplicata* an ancestor of *contracta*. I have figured a French Pliocene species of this group, *G. dupuyi* (pl. 22, figs. 1, 2, 4) to show the resemblance. It will be noted that the angular and parietal lamellæ are wholly concrescent, and the parietal turns towards the periphery at its inner end; also it has a direct inward spur (pl. 22, figs. 2, 4), some trace of which can be seen in the recent American *G. armifera* also. The columellar lamella turns down at the inner end (fig. 4), and the palatal plicæ stand upon a callous ridge. These are characters of both the *armifera* and *contracta* groups of *Albinula*, which indicate, at least, that the American and European species are of common immediate ancestry, though it appears to me that the European stock is a little too special-

ized to have been directly ancestral to the American. It appears likely that the European species of *Albinula* were derived from Asia in early Oligocene times, together with *Sinalbinula* (*didymodonta* group) and many other land shells, rather than that the Asiatic and American forms came from Europe. It is remarkable that *Albinula*, while it gave off numerous mutations, changed very little from the Middle Oligocene to the Pliocene, where *G. dupuyi* and *G. fossanensis* surely differ but little from the earliest known European *Albinula*, *G. quadriplicata*. Whether the *Albinula* group arose in Asia or North America is an open question at present. It was certainly a mature group at the time of its first known appearance in Europe.

The other groups of European Tertiary Gastrocopts belong to the Asiatic section *Sinalbinula*, so far as I can determine from the literature and a few specimens. Some of them, such as the Upper Oligocene *G. fissidens* Sandb., have the three lamellæ of the parietal wall well separated, as in the recent *G. chichijimana* and *ogasawarana*, which seem to be ancient forms, preserved by their isolation. Other and later species, such as *G. baudoni*, from the Pliocene of Hauterive (pl. 21, figs. 13, 14) have wholly concrescent angular and parietal lamellæ and no infraparietal, and resemble very closely the recent *G. coreana* in all structural characters. Whether *G. baudoni* is an advanced descendant of *G. obstructa*, or has more direct relations with Asiatic forms due to later migrations, cannot now be determined. Recent representatives of the same group (*Sinalbinula*) are *G. pleimesi* of Abyssinia and *G. theeli* of Trans-caucasus. Both are known to me only by descriptions and figures, the latter too small to be any use in the study of phylogenies.

Subgenus ALBINULA (See p. 13).

Series of G. quadriplicata.

46. GASTROCOPTA QUADRIPLICATA (Al. Braun). *Pupa quadriplicata* AL. BR., in Walchner's Geognosie, 2. Aufl., (1851?) p. 1135.—*Leucochilus quadriplicatum* (Al. Br.) BOETTGER,

Jahrb. Nassauischen Vereins Naturkunde, Jahrg. 42, 1889, p. 277.—KLIKA, Tert. L. u. Süsswasser Conch. Böhm, p. 91.—*Vertigo turgida* REUSS, Palæontographica ii, 1852, p. 30, pl. 3, fig. 8 (Tuchoritz). Middle and Upper Oligocene and Miocene, Germany and Bohemia.

G. Q. LAMELLIDENS (Sandberger). *Pupa lamellidens* SANDB., Mainzer Becken, 1863, p. 55, pl. 5, fig. 8; Vorwelt, p. 398. Upper Oligocene, Tuchoritz, etc., Bohemia. Considered by Boettger to be a local variety of *quadriplicata*.

47. GASTROCOPTA QUADRIDENTATA (Klein). *Pupa quadridentata* KL., Jahresh. Ver. Vaterl. Naturk. in Württemberg, ix, 1853, p. 216, pl. 5, fig. 13.—*Pupa* (*L.*) *quadridentata* Kl., MILLER, Jahresh. Wurttemb. Nat. Ver. 1900, p. 399, pl. 7, fig. 17. Upper Miocene, Germany.

48. GASTROCOPTA SUEVICA (Sandberger). *P.* (*Vertigo*) *suevica* SANDBERGER, Vorwelt, 1875, p. 654.—*Pupa* (*Leucochilus*) *suevica* Sandb. MILLER, Jahresh. Wurttemb. Nat. Ver. 1900, p. 398, pl. 7, fig. 16, with var. *minor* Miller. Upper Miocene, Steinheim.

49. GASTROCOPTA LARTETI (Dupuy). *Pupa larteti* DUP., Journ. de Conchyl., i, 1850, p. 307, pl. 15, f. 5.—*Vertigo larteti* Dup., BOURGUIGNAT, Hist. Malac. de la Colline de Sansan, 1881, p. 71. Middle Miocene, Sansan, southwestern France.

50. GASTROCOPTA DUPUYI (Michaud). Pl. 22, figs. 1, 2, 4. *Vertigo dupuyi* MICH., Annales Soc. Linn. de Lyon, n. sér., ii, 1855, p. 46, pl. 5, f. 12, 13. Pliocene, Hauterive, (Drôme), France.

51. GASTROCOPTA FOSSANENSIS (Sacco). *Vertigo fossanensis* SACCO, Mem. R. Accad. Torino, 2 ser., vol. 37, 1885, p. 31, pl. 2, f. 4.—*V. f.* var. *quatuordentata* SACCO, Atti Soc. Sc. Nat. Milano, vol. 29, 1886, p. 49, pl. 2, f. 11.—*Scarabella fossanensis* and var. *quatuordentata* SACCO, Moll. Terz. Piemont, p. 70, pl. 6, f. 5, and var. *q.*, f. 6. Upper Pliocene, Fossano, Piedmont. From the figures, Boettger thought these identical with *quadridentata* and *quadriplicata*, respectively; yet it seems likely that some differences exist.

Subgenus SINALBINULA (See p. 103).

Series of G. nouletiana.

52. GASTROCOPTA NOULETIANA (Dupuy). *Pupa nouletiana* DUP., Journ. de Conchyl., i, 1850, p. 309, pl. 15, f. 6.—BOETTGER, Palæontographica, Bd. 24, 1877, p. 194, pl. 24, f. 5. —*Leucochilus nouletiana* Dup., BOETTGER, Bericht Senckenb. Nat. Ges., 1884, p. 272, pl. 4, f. 11*a, b*, and var. *gracilidens* Sandb., pl. 4, f. 12-13.—*Vertigo nouletiana* Dup., BOURGUIGNAT, Malac. Sansan, p. 73, pl. 4, f. 92-95. — ? *Vertigo ludovici* BGT., t. c, p. 75.— ? *Vertigo nouleti* MICHAUD, Journ. de Conchyl., 1862, p. 77, pl. 4, f. 1, Hauterive (*Pupa n.*, on plate). Middle Miocene, Sansan, Lake Balaton, etc.

52*a*. G. N. GRACILIDENS (Sandberger). *Pupa gracilidens* SANDB., Vorwelt, 1875, p. 600. Lower Miocene of Schleusenkammer, and Upper Miocene of Undorf bei Regensburg.

52*b*. G. N. FARCIMEN (Sandberger). *Pupa* (*Vertigo*) *farcimen* SANDB., Vorwelt, 1875, p. 600, pl. 29, f. 24. Upper Miocene, Undorf, Zant bei Ingolstadt, etc.

The status of the following five species from the colline of Sansan is uncertain; probably all belong to one species of Gastrocopta. The figures are poor. VERTIGO BARRERI Bourguignat, Hist. Malac. de la Colline de Sansan, 1881, p. 76. VERTIGO CHYDAEA Bgt., t. c., p. 77. VERTIGO EUCRINA Bgt., p. 79. VERTIGO TAPEINA Bgt., p. 80. VERTIGO NECRA Bgt., p. 81.

Series of G. didymodonta.

53. GASTROCOPTA DIDYMODONTA (Al. Braun). *Vertigo didymodonta* AL. BR., in Walchner's Geognosie, 2. Aufl., (1851?), p. 1135.—*Pupa didymodus* Al. Br., SANDBERGER, Mainzer Becken, p. 57, pl. 5, f. 14.—*Leucochilus didymodus* Al. Br., BOETTGER, Jahrb. Nassau. Ver. Nat., vol. 42, 1889, p. 283. Upper Oligocene, Hochheim.

54. GASTROCOPTA HETERODUS (Boettger). *Pupa* (*Leucochilus*) *heterodus* BTTG., Neues Jahrb. für Mineralogie, etc., 1877, p. 80.—MILLER, Jahresh. Württemb. Nat. Ver., 1900, p. 398, pl. 7, f. 14. Upper Miocene, Steinheim.

55. GASTROCOPTA MUNIERI (Deshayes). *Pupa munieri* DESH., Anim. sans Vert. Bassin Paris, ii, 1864, p. 858, pl. 56, f. 25-27. Oligocene, Limestone of Beauce, near Étampes.

56. GASTROCOPTA FISCHERI (Deshayes). *Pupa fischeri* DESH., l. c., f. 34-36.

57. GASTROCOPTA BIFIDA (Desh.). *Pupa bifida* DESH., t. c. p. 860, pl. 56, f. 19-21. This species and the two preceding, from the same formation and locality, have been placed in the synonymy of *B. didymodus*, but not from a comparison of specimens. Their status and exact horizon are uncertain.

58. GASTROCOPTA OBSTRUCTA (Al. Braun). *Pupa obstructa* AL. BR., in Walchner's Geognosie, 2. Aufl., (1851?), p. 1135. —*Leucochilus obstructum* Al. Br., BOETTGER, Jahrb. Nassau. Ver. Nat., 42, 1889, p. 284.—*Pupa obstructa* var. *francofurtana* BOETTGER, Palaontographica, 24, 1877, p. 195, pl. 29, f. 6 (Affenstein near Frankfurt). Lower Miocene, Schleusenkammer bei Niederrad.

59. GASTROCOPTA FISSIDENS (Sandberger). *Pupa fissidens* SANDB., Conchyl. Mainzer Becken, 1863, p. 57, pl. 5, f. 16.—*Leucochilus fissidens* Sandb., BOETTGER, Jahrb. Nassau. Ver. Nat., 42, 1889, p. 285.—JOOSS, same Jahrb., vol. 64, 1911, p. 65. Upper Oligocene of Hochheim; Hydrobia beds of the Lower Miocene of Mosbach-Biebrich and Wiesbaden.

60. GASTROCOPTA FERDINANDI (Andreae). *Leucochilus ferdinandi* ANDREAE, Mittheil. Römer Mus., No. 18, 1902, p. 18, f. 9. Miocene of Oppeln, Silesia.

61. GASTROCOPTA BAUDONI (Michaud). Pl. 21, figs. 13, 14. *Vertigo baudoni* MICH., Journ. de Conchyl. 1862, p. 76, pl. 4, f. 2 (*Pupa b.*, on plate). Pliocene, Hauterive.

62. GASTROCOPTA LONGIDENS (Clessin). *Pupa* (*Leucochila*) *longidens* CLESSIN, Berichte Naturwiss. Vereines zu Regensburg, xiii Heft, 1912, p. 105. Middle Miocene, Undorf near Regensburg.

63. GASTROCOPTA UNDORFENSIS Pils., n. n. *Pupa* (*Leucochila*) *miliolum* CLESSIN, t. c., p. 106. Not *Pupa miliola* Orbigny. Same locality. This species and the preceding have not been figured, and their relations to the other species are not known to me.

Recent Species.

64. GASTROCOPTA THEELI (Westerlund). Pl. 21, fig. 11.

Shell dextral, ovate-oblong, cylindroid, obtuse, white, opaque, smooth. Whorls 5½, convex, slowly increasing, parted by a very oblique, deep suture, the last whorl large, rounded at base, ascending anteriorly, encircled by a transverse callous behind the aperture, constricted between the callous and aperture. Aperture rounded, 5-toothed: parietal tooth lamelliform, high, subrectangular above, impressed in the middle; two palatal teeth, deep, short, connected by a callous; two columellar teeth, the upper one transverse, the inferior obsolete, tooth-shaped. Peristome a little reflected, the margins joined by a thin callous, outer margin partly more curved, obsoletely angular above. Length 2¼, diam. 1¼ mm. (*Westerlund*).

Siberia: Mikoulina, type loc. (Westerlund). Trans-Caucasia at Poti, in debris of the Rion (Boettger).

Pupa theeli WESTERL., Kongl. Svenska Vet.-Akad. Handlingar, n. f. vol. 14, pt. 2, p. 102, pl., figs. 4*a-c*, 1877; Fauna Palaarct. Binnenconchyl. iii, 1887, p. 129.—*Leucochilus theeli* (West.) BOETTGER, Jahrb. Nassauischen Vereins Naturkunde, Jahrg. 41, 1888, p. 286.

The shell is said to be very similar to *Carychium minimum* in form, color and size. It has not been well figured. Dr. Boettger states that it is almost identical with the Miocene *B. fissidens* Sandberger, which he regards as in all probability a direct ancestor of *theeli*. The inferior columellar tooth described is evidently the basal fold. It belongs to the section *Sinalbinula*.

V. SPECIES OF AFRICA AND THE MASCARENE ISLANDS.

The few African Gastrocoptas yet known belong, with the exception of *B. pleimesi*, to the restricted subgenus *Gastrocopta*. The northern species (Abyssinia) are related to Asiatic forms; those from West Africa, and South Africa like the Mascarene species, seem much more closely allied to tropical American Gastrocopts. They are figured on plate 22.

The extreme similarity of some African and Mascarene species to those of the Antilles naturally suggests that they may be the slightly changed descendants of Antillean specimens, imported on plants or otherwise by commerce, as species of *Opeas* and *Subulina* have certainly been spread. But there are facts which cause me to hesitate before accepting the hypothesis of recent introduction. We must consider the occurrence of such forms in the most out-of-the-way places; the wide distribution in Africa of *G. damarica*, in the Cape Verdes of *G. acarus*. We may have here a case of parallel modifications of very old and slowly changing forms. Moreover, each species is to be considered separately. Some localities are more likely to receive importations than others.

Species of Continental Africa and the Cape Verdes.

Subgenus SINALBINULA (see pages 11, 103).

65 GASTROCOPTA PLEIMESI (Jickeli). Pl. 22, figs. 5, 6.

Shell narrowly rimate, cylindric oval, whitish, diaphanous, glossy, under a lens longitudinally irregularly substriate, covered with dirt. Spire slowly tapering, the apex obtuse. Whorls 5, convex, regularly increasing, the last one-third the length, 3-pitted, subcompressed basally, the neck rather rounded, suture deep, slightly oblique. Aperture subcircular, 7-folded: two parietal folds, the right one almost bipartite by a deep sinus (the anterior part smaller, acuminate, the back part larger), the left one forming a minute denticle; two columellar folds, the lower one in the angle of columellar and basal margins. Three parietal plicæ, the upper punctiform, middle one larger, the third longest. Peristome a little expanded, sublabiate, white, the margins joined by a thin, line-like callous. Length 2⅛, diam. 1, aperture alt. ⅝, width ¾ mm. (*Jickeli*).

Abyssinia: Habab Mts., Nakfa, in the gorge of Asqaq, 5664 ft. elevation, on bits of wood under rotten leaves and stony talus (Jickeli).

Pupa pleimesi JICK., Malak. Bl., 1873, p. 106; Nova Acta, vol. 37, p. 117, pl. 5, f. 9.

"In form and color it brings to mind *P. klunzingeri*, but is distinguished from this at once by the second tooth on the parietal wall, the second columellar, and the third palatal plica, also by the narrower umbilicus and the fine striation" (*Jickeli*).

It may be related to *B. didymodonta* and the Japanese species. I have not seen it.

Subgenus GASTROCOPTA (see page 53).

66. GASTROCOPTA KLUNZINGERI (Jickeli). Pl. 22, fig. 3.

Shell rimate, cylindrically ovate, whitish, diaphanous, under a lens strongly, arcuately ribbed, covered with dirt. Spire slightly tapering, the apex a little obtuse. Whorls 5, inflated, the last somewhat compressed basally, unisulcate; suture deep. Aperture semiovate, 5-folded: one high parietal fold, parted by a median sinus, the back part higher; one strong columellar fold; two palatal plicæ, the second larger; one acute tooth at the base of the aperture. Peristome reflected, a little expanded, white, the margins joined by a thin callous. Length 2¼, diam. 1¼, aperture alt. 1, width ⅘ mm. (*Jickeli*).

Abyssinia: Prov. Hamaszen, on the road from Genda to Asmara, on the tableland of Rora-Beit-Andu; Mekerka, on the bank of the Toquor; Bogos, on the mountains of Keren; under decaying leaves on bits of wood and stones (Jickeli).

Pupa klunzingeri JICK., Mal. Bl., 1873, p. 106; Reisebericht., p. 44, 46; Fauna der Land- und Süsswasser-Mollusken Nord-Ost-Afrika's, in Nova Acta K. Leop.-Carol. Deutschen Akad. Naturforscher, Bd. 37, no. 1, 1874, p. 116, pl. 5, f. 8.

The thread-like striæ and unusually convex whorls are conspicuous external marks of this species. In an obliquely basal view the parietal and angular lamellæ are seen to form a continuous lamella, the angular rising in a lobe where it overrides the anterior end of the parietal, and tapering forwards. The inner end of the parietal lamella curves noticeably towards the periphery; a character noted also in *G. mimula*, *G. damarica*, and possibly to be found in other African Gas-

trocopts of this group. The columellar lamella is stout and horizontal.

G. mimula of Ceylon is related, but larger and less regularly rib-striate.

66*a*. *G. klunzingeri senegalensis* (v. Maltzan).

Differs from the type of Abyssinia by having the whorls a little more densely and more delicately costulate; the parietal fold less distinctly bifurcate, the first and third palatal plicæ either weaker or wanting. Length 2¼, diam. 1¼ mm. (*v. Maltzan*).

Senegal: Nianing, in woods.

Pupa (Leucochilus) klunzingeri Jick., var. *senegalensis* v. Maltzan, Nachrbl. Deutsch. Malak. Ges., xxii, 1890, p. 48.

67. Gastrocopta hermosa (Jousseaume). Pl. 22, fig. 7.

Shell perforate (perforation subpervious, rather deep, punctiform in the center), very minute, oblong-elongate, subdiaphanous, fragile, polished, pale corneous. Spire rather produced, tumid in the middle, obtuse at summit. Whorls 5 to 6, very ventricose (the upper and median as far as the antepenult. tumid and very much rounded), rather rapidly increasing, separated by a very deep suture. Last whorl rotund, compressed towards the aperture, angular below around the perforation, straight above at the insertion. Aperture vertical, subquadrangular-ovate, a little straightened externally, 3-toothed (one parietal tooth above, strong, very prominent, lamelliform, prolonged to the insertion of the outer lip; another equally strong on the upper part of the columella; finally a rather immersed denticle in the base of the aperture). Peristome acute, patulous, a little thickened within; columellar margin robust, thick and reflected; margins joined by a strong callous. Length 2, diam. 1 mm.; aperture ⅓ mm. high and wide (*Jouss.*).

Eritrea: Massaua (Jousseaume).

Vertigo hermosa Jouss., Bull. Soc. Malac. France, vii, 1890, p. 87, pl. 3, f. 14, 15.

Dr. Jousseaume remarks that this very small shell, found under rubbish in a rock crevice, is very remarkable for the

extremely swollen median and upper whorls compared with the lower ones. The obesity of the fourth whorl especially is so pronounced that it appears larger than the following one.

This species, which I have not seen, is obviously related to *B. klunzingeri*, which is from a higher, more humid region. *B. hermosa* is smoother, and apparently wants upper palatal and basal plicæ, which are developed, but small, in *B. klunzingeri*, though reduced or wanting in the var. *senegalensis*. Both are remarkable for the extreme convexity of the whorls. Description and figure are from Jousseaume.

68. GASTROCOPTA ACARUS (Benson). Pl. 22, figs. 8, 10, 13.

Shell rimate-perforate, cylindric-oval, very minute, corneous, pellucid, the suture impressed, apex rather obtuse; whorls nearly 5, convex. Aperture rounded-ovate, 6-plicate: one strong, lamelliform, irregular median parietal, 2 columellar, of which the upper is minute, the lower strong and transverse, and 3 short, not very deep palatal teeth, of which one is basal and the next is larger. Peristome thin corneous, shortly, angularly expanded throughout, lightly margined within. Length 1¾, diam. ¾ mm. (*Bens.*).

Cape Verde Archipelago: S. Vicente, under stones (E. L. Layard, type loc.); S. Antao, S. Vicente, S. Nicolao, S. Iago and Fogo, especially under the dead, loosened bark of Euphorbias.

Pupa acarus BENS., Ann. and Mag. of N. H. (2), xviii, 1856, p. 435.—PFR., Monogr. Hel. Viv., iv, 686 (1859).—DOHRN, Malak. Bl., xvi, 1869, p. 12.—MORELET, Journ. de Conchyl., xiii, 1873, p. 242.—WOLLASTON, Testacea Atlantica, 1878, p. 515.—*Pupa acavus* SCHAUFUSS, Paetel's Catal., 1869, p. 84.

This species is thickly coated with dirt when alive. It is much like *G. damarica*, which differs by having a low callous on the columellar side of the angulo-parietal lamella, and a slightly less thickened lip. The Antillean *G. pellucida* has some forms extremely close to *acarus*, though perhaps not absolutely identical. In my opinion, *G. acarus* is intermediate between *pellucida* and the simpler of the forms I have de-

scribed as races of *barbadensis*. A somewhat more synthetic view than I have taken would unite *pellucida* and *barbadensis* through the several races of each; but so long as they are kept as separate species, *acarus* also may stand. In islands so excessively arid as the Cape Verdes, it seems rather unlikely that an Antillean species would be imported and spread almost all over the archipelago.

The angulo-parietal lamella is formed as in *B. servilis*, there being a lobe directed towards the periphery at the junction of the angular and parietal portions (pl. 22, fig. 10). The upper columellar fold alluded to by Benson is really an infraparietal, "being absent, or sometimes just represented by an extremely minute and scarcely perceptible, very deeply immersed, rounded tubercle," as Wollaston has noted. The columellar lamella is stout and horizontal throughout, rather short. The upper palatal plica is stout and short, the lower strong, long, and entering; basal plica rather small, tubercular. The well-reflected peristome is distinctly but not greatly thickened within, and of a cinnamon-buff color. As usual the thickening disappears at the upper curve of the lip. A rather thick parietal callous connects the converging ends of the lip. The color is very pale cinnamon-buff, sometimes transparent enough to show the axis faintly through the last whorl. Striation is extremely faint. There is no noticeable crest behind the lip. Length 1.95, diam. 0.9 mm.; 4⅔ whorls.

This species is the type of the genus *Gastrocopta*. It has not been figured before, and its affinity to Antillean species has not been noticed.

69. Gastrocopta microbus (Dautzenberg). Pl. 22, fig. 9.

Shell small, umbilicate, subpellucid, rather thin. Spire elevated, turrited, suture deep. Whorls 5, above a little depressed, then strongly convex, obliquely very finely striatulate. Aperture rounded, the peristome continuous, expanded, 4-toothed; one strong parietal fold, one minute columellar, two in the right margin, the upper one rather short. Color dirty corneous. Length 2, diam. 1 mm.; aperture ⅔ mm. high, ⅔ wide (*Dautzenberg*).

Upper Senegal: Médine, under a stone (Em. Dorr).

Pupa microbus A. Morelet MS., Dautzenberg, Mém. Soc. Zool. de France, 1890, p. 129, pl. 1, f. 5*a*, *b*.

It is placed in *Gastrocopta* with some doubt, as nothing is said of a bifid parietal tooth.

70. Gastrocopta annobonensis (Girard).

Shell small, oval, elongate, having a narrow umbilical chink; corneous, subtransparent, marked with fine and regular striæ. Whorls 5, quite convex, with a well-marked, deep suture. Last whorl slowly ascending near the aperture, about one-third the total length, a little compressed into an obtuse carina at the base. Aperture subvertical, somewhat rounded, obstructed by teeth and folds. Peristome thick, well reflected, the margins united by a strong callous which makes them seem nearly continuous. Columellar margin straight, armed with one fold; parietal wall having a quite sinuous, more developed fold; outer margin quite sinuous, having 3 or 4 teeth or dentiform folds quite deep within. Length 2¼, diam. 1 mm. (*Girard*).

Island of Anno-Bom (F. Newton).

Pupa Anno-Bonensis Girard, Journal de Sciencias Math., Phys. e Naturaes, Ac. Real Sci. Lisboa, Ser. 2, iii, Feb. 1894, p. 207.

71. Gastrocopta flocculus (Morelet). Pl. 22, figs. 11, 12.

Shell rimate, ovate, smooth, somewhat shining, corneous-rufous. Whorls 5½, convex, joined by an impressed suture, the last a little more than one-third the length. Aperture ovate-circular, 4-toothed: one compressed, entering tooth on the parietal wall, near the insertion; one on the columella, the rest in the outer margin, the upper one smaller. Peristome simple, thin, a little expanded throughout. Length 3, diam. 1½ mm.

West Africa: shore of the lake of Quilunda, district of Icolo and Bengo, Angola, on the leaves of *Pistia stratioides*.

Pupa flocculus Morelet, Voyage du Dr. Friederich Welwitsch dans les royaumes d'Angola et de Benguella, Mollusques, 1868, p. 81, pl. 3, f. 4.

Description and figures are from Morelet.

72. GASTROCOPTA DAMARICA (Ancey). Pl. 22, figs. 14, 15, 16.

"Shell subcylindrically-oblong, rather slender, small, rather thin, corneous, perforate, somewhat shining, obliquely and closely striatulate, smoother towards the apex. Spire but little tapering, the summit large, very obtuse. Whorls 5½, regularly increasing, convex, separated by a deep and distinctly oblique suture, slowly increasing, but scarcely in diameter, to the penult whorl, the last whorl convex on the side, little tapering, somewhat ascending at the aperture. Aperture oval, slightly lunate, nearly vertical, five-toothed within, as follows: A small, acute columellar tooth; a large, lamelliform, twisted, entering tooth at the upper angle of the aperture; a small subbasal tooth; and two denticles within the outer margin, the first before, the second past the middle (this one larger and more deeply placed). Peristome expanded, the margins joined by a callous, whitish, dilated and spreading at the base and columellar margins. Length 2½, diam. 1 8, length of aperture ⅔, width ½ mm." (*Ancey*).

Southwest Africa, Ovampoland: Disappointment Key [Vlei] (Anderson and Chapman); collections of Marie and Layard (Ancey).

Transvaal: Rustenberg (McBean); Potchefstroom (Miss Livingston); Johannesburg (McBean); Pretoria; Heidelberg; Buiskop; Pieterburg; Pruizen (Connolly).

Orange Free State: Bloemfontein (Connolly).

Cape of Good Hope: Prieska (Gibbons); Elandsberg Mountain, Cradock (*ridibunda*); Port Elizabeth (Farquhar).

Pupa damarica ANCEY, Le Naturaliste (Sér. 2), ii, 1888, p. 200.—BURNUP, Ann. Mag. N. H. (8), vii, 1911, p. 403.—*Leucochilus damaricum* (Anc.), BOETTGER, Abhandl. Senckenb. naturforsch. Ges., xxxii, 1910, p. 446.—*Jaminia damarica* (Ancey), CONNOLLY, Ann. South African Mus., xi, pt. 3, 1912, p. 179, no. 344.—*Pupa ovampoensis* MELVILL and PONSONBY, Ann. Mag. N. H. (6), ix, 1892, p. 91, pl. 6, f. 11 (bad); (8), i, 1908, p. 79, pl. 2, f. 16.—*Pupa ridibunda* MELVILL and PONSONBY, Ann. Mag. N. H. (7), viii, 1901, p. 320, pl. 2, f. 11.

"This little species belongs to the same group as *Pupa rupicola* Say, *P. pellucida* Pfr., *P. tripunctum* Morelet, etc." (*Ancey*).

This *Gastrocopta* has a wide distribution in South Africa, as recorded by Connolly. It is astonishingly similar to the Antillean *G. pellucida*, but differs by having the terminations of the peristome closer together, and often connected by a barely raised lamina, though in other specimens they are not actually continuous, the very short parietal film being wholly appressed. As in *G. pellucida*, there is a little projection on the columellar side of the angulo-parietal lamella, representing the forward end of the parietal lamella (fig. 16). The figures are from specimens from Pienaar's Poort, Transvaal, received from Mr. Connolly. In this lot the size varies from length 2.1, diam. above aperture 0.9 mm. to 1.9 x 0.85 mm. Mr. Burnup gives the dimensions of one of the "lirate var." from Rustenberg as length 2.25, diam. 1 mm.

P. ovampoensis M. & P. was placed in the synonymy of *P. damarica* by Boettger; Messrs. Burnup and Connolly have concurred. As it was described from Layard's collection, and Ancey stated that his species was in that collection, it seems likely that the types of both were from the same lot. There was some error in Ancey's statement of the diameter. Perhaps he intended to write 1⅛ mm., as Mr. Burnup has it. According to Burnup, a very large specimen in his collection from Johannesburg measures 2.5 mm. long, 1.11 diam.

In a later paper Melvill and Ponsonby place *P. ridibunda* in the synonymy of *ovampoensis*, stating that "every intermediate occurs." Mr. Burnup takes the same view. The original description, given below, does not notice the palatal plicæ, but these were also overlooked in the original account of *ovampoensis*.

Pupa ridibunda. "Shell minute, subrimate, brown, thin; whorls 6, of which the apical is depressed, vitreous, the rest impressed at the sutures, ventricose, closely, obliquely striate under a lens; aperture rotund; peristome brownish, continuous, and (particularly at the columellar margin) a little thickened; provided with three fold-like teeth: a rather prom-

inent bifid parietal fold; an acute basal tooth; an entering bifurcate columellar fold. Length 2, width 1 mm.

"Under low trees at base of Elandsberg Mountains (Farquhar). A ventricose little species, with continuous peristome and complicated arrangement of mouth-processes" (*Melvill & Ponsonby*).

73. GASTROCOPTA DUPLICATA (Preston). Pl. 41, fig. 3.

Shell small, sinistral, cylindrically ovate, rimate, brown; whorls 5, the first four regularly increasing, the last ascending in front, having a somewhat weathered appearance; suture well impressed; umbilicus reduced to a narrow chink; columella descending in a curve, labrum continuous, white, slightly reflexed, obtusely angled above on the outer side; aperture roundly ovate, armed with two short, erect, parietal lamellæ placed the one almost above the other, the lower of which is very interiorly situate, a tubercular lamella on the columella and a sub-basal lamella on the outer lip, above which and well inside the shell occurs a small denticle. Alt. 3.25, diam. maj. 1.75 mm.; aperture: alt. 1, diam. .5 mm. (*Preston*).

British East Africa: between Rumruti and Mount Kenia.

Fauxulus duplicatus PRESTON, Ann. Mag. N. H. (8), vii, May, 1911, p. 470, pl. 11, f. 22.

The figure, copied from Preston's, is very poor. The species is certainly not a *Fauxulus*. It appears to be a sinistral *Gastrocopta*. The name is prior to *Bifidaria duplicata* Sterki, which may be called *Gastrocopta procera sterkiana* (p. 65).

Species of the Mascarene and other Islands in the Indian Ocean (Bourbon, Mauritius, Rodriguez, Seychelles, Comoros, Nossi-bé).

These forms are illustrated on plate 23. They belong to the typical subgenus *Gastrocopta*. They are so closely interrelated that one is inclined to think them local races of a single species, which may have been carried about on plants within the period of human occupation. The resemblance to the equally widespread Antillean species *G. servilis* is very

close. I have been much inclined to think the Mascarene forms imported, yet they occasionally develop a low crest behind the lip, which I have never seen in *G. servilis*. In the allied species this is a very variable character, of but slight significance.

The angulo-parietal lamella is like that of *G. servilis*, the completely concrescent angular and parietal portions meeting at a very wide angle directed towards the periphery, producing an emargination or somewhat bifid appearance in a front view. This appearance is most marked in *tripunctum*, least in *seignaciana*.

Key to Species.

a. Shell larger, from nearly 2 to over 2.5 mm. long.
b. Angulo-parietal lamella distinctly bifid in a front view. *G. tripunctum*, no. 75.
b^1. Angulo-parietal lamella emarginate in a front view.
c. Teeth strong, the basal plica well developed. *G. microscopica*, no. 76.
c^1. Teeth weaker, basal plica typically minute or wanting. *G. seignaciana*, no. 74.
a^1. Shell smaller, decidedly less than 2 mm. long.
b. Rather slender, of 5 whorls. *G. lienardiana*, no. 77.
b^1. Stouter, of 4⅓ whorls. *G. l. eudeli*, no. 77*a*.

74. GASTROCOPTA SEIGNACIANA (Crosse et Fischer). Pl. 23, figs. 1 to 4, 6.

Shell rimate, small, of a lengthened subcylindric shape, slightly striate obliquely, thin, subtranslucent, moderately shining, of a corneous color. Spire relatively quite long, the summit rather obtuse; suture impressed. Whorls 5½, a little convex, the last shortly rounded basally. Aperture vertical, lunate-rounded, narrowed by two parietal teeth, one larger, and of quite irregular form; interior colored like the rest of the shell. Peristome simple, corneous, the margins separated, columellar margin reflected, basal margin rounded, reflected, outer margin a little reflected, ascending, subangular near the upper insertion, tapering, and ascending above the parietal

teeth. Length 2¾, diam. ¾ mm.; aperture ¾ mm. long and wide (*C. & F.*).

Nossi-bé at Calempo, type loc. (E. Marie); also Nossi-Comba, under the bark of tamarinds, in company with *Buliminus variolosus* (E. Marie).

Pupa seignaciana C. & F., Journal de Conchyl., xxvii, 1879, p. 49; xxix, 1881, p. 199, pl. 8, f. 4.

"The specimen figured [pl. 23, fig. 6] has only two parietal teeth. According to M. Marie, the fully adult individuals collected by him at Calempo have, besides the two parietal teeth, two other denticles situated in the outer margin, of which one should be scarcely noticeable" (*C. & F.*).

The figure given by Messrs. Crosse and Fischer shows that there are not "2 dents pariétales" but one parietal and one columellar. The shell was evidently immature. There is a grave inconsistency in Crosse's measurements, which would make the diameter contained 3⅔ times in the length, an unheard-of ratio. According to the figure, the diameter is nearly half of the length. Few authors have taken the trouble to measure or describe small Pupæ accurately, and in this case I believe that both length and diameter were given incorrectly.

Three specimens from the type locality, received from M. E. Marie, are in the collection of the Academy, no. 22926. Two of these, the longest and shortest, are drawn in pl. 23, figs. 1 to 4.

The shell varies somewhat in shape. It is cinnamon-buff, with light, irregular striation. There is a very slight, scarcely noticeable contraction behind the well-expanded outer lip, or a distinct but quite low crest. The angular and parietal lamellæ are concrescent into a single slightly sinuous lamella, which is highest in the middle, tapering forward. The middle part is bent towards the periphery, giving an emarginate appearance in front view. The columellar lamella is strong and horizontal. Upper palatal plica is very short, tubercular. Lower palatal much larger and longer, more deeply placed. The basal plica is extremely low and small, not whitish like the other teeth, in one specimen, and not visible in another. The peristome is slightly thickened within, pale brown.

Length 2.5, diam. above aperture 1.06 mm.; aperture 0.8 mm. long (figs. 1, 4).

Length 2.2, diam. above aperture 1.03 mm.; aperture 0.75 mm. long (figs. 2, 3).

The structure is that of *G. servilis* except for the absence of a basal plica or its reduction to a minute rudiment, as in *G. s. riisei.* The latter has slightly smaller columellar and parietal lamellæ. Compare also *G. lyonsiana* Ancey, which is scarcely separable from *seignaciana.*

In one specimen in the lot from Nossi-bé there is a distinct though low rounded crest behind the lip, of the same color as the shell, and flattened out near the suture. Aperture as described above, except that the basal plica is well developed. Without more material I am unable to decide whether this is a different race, or, as seems more likely, an extreme variation of *seignaciana.* It is this specimen which causes one to doubt the specific distinction of *G. microscopica.*

75. GASTROCOPTA TRIPUNCTUM (Morelet). Pl. 23, figs. 5, 7, 12.

Shell minute, oblong, thin, entirely smooth, glossy, diaphanous, corneous; apex rather obtuse. Whorls 6, convex, the last compressed basally, having two or three grooves behind the lip. Aperture ovate-rotund, contracted by a strong parietal lamina, another on the columella, and three punctiform in the basal and outer margins. Peristome reddish, narrowly expanded throughout. Length 3, diam. 1½ mm. (*Morelet*).

Comoro Is.: Mayotte (E. Marie).

Pupa tripunctum MORELET, Journal de Conchyl., xxx, 1882, p. 189, pl. 10, f. 4.

This small *Pupa* may be compared, at least as to shape and size, with *P. lienardiana* Crosse, of Mauritius. But besides that it is smaller and formed of less convex whorls, the teeth are not of the same form in the two species, and are not arranged in the same manner. The three punctiform teeth placed at equal distances on the peristome of *P. tripunctum,* are replaced in *P. lienardiana* by a single basal denticle and by two others immersed in the throat of the shell. It is, moreover, not to be confused with *P. exigua* Ad., which has only

3 denticles, or with *P. minutalis* of Mayotte, with 6. Finally, in *P. monas*, of Anjouan, also having 5 denticles, their arrangement is absolutely different, not to speak of the size, which in *P. tripunctum* is double that of the other (*Morelet*).

This species, which is figured from topotypes received from M. E. Marie, doubtless part of the original lot, is very closely related to *G. seignaciana* and *G. microscopica*. It differs by having a higher lobe on the angulo-parietal lamella (pl. 23, fig. 7), which gives that tooth a strongly bifid aspect in a front view, similar to the American *G. procera* or *barbadensis*. There is no material difference between *tripunctum* and *microscopica* in the palatal and basal plicæ. It seems likely that Morelet's measurement was too liberal — he may have guessed at it. His figure is copied, pl. 23, fig. 5. The specimen figured (figs. 7, 12) measures, length 2.15, diam. 1 mm., and the smallest individual seen is 1.9 mm. long.

76. GASTROCOPTA MICROSCOPICA (Martens). Pl. 23, figs. 8, 13, 14, 15.

Very small, 2⅓ mm. long, not quite 1 broad, cylindric ovate, dark brown, glossy, smooth; 5 weakly convex whorls, the upper three more rapidly increasing in width than the following. Aperture ⅔ mm. long, ovate, with weakly reflected margin; a tooth on the parietal wall near the outer angle, a strong one on the columella, and two within the outer lip, of which the upper is smaller than the lower (*von Martens*).

Seychelles: Mahé, Anse aux Pins, under fallen cocoanut leaves, on the shore plain; Island aux Frégates (east of Mahé), on old, fallen cocoanut shells (Dr. Aug. Brauer).

Pupa microscopica Nev., VON MARTENS, Land- und Süsswasser-Mollusken der Seychellen, in Mittheilungen aus der Zoologischen Sammlung des Museums für Naturkunde in Berlin, i, March, 1898, p. 25, pl. 2, f. 19.

? *Pupa (Vertigo) microscopica* G. NEVILL, Hand List Mollusca in the Indian Museum, Calcutta, i, 1878, p. 197 ("*Carychium mauritianum* of Mascarene collectors").

Nevill gave no description of his species *P. microscopica*, the

type locality being "on old walls near Port Louis, Mauritius." He recorded it also from Bourbon, from Morelet's collection. As von Martens had not seen types or topotypes of Nevill's species, the identity of Nevill's Mauritian and von Martens' Seychelles species is hypothetical. The question of identity is academic, since Nevill's *P. microscopica* was never defined. The species from Praslin, Seychelles, mentioned by Nevill as *Carychium n. sp.* in Proc. Zool. Soc., 1869, p. 65, was subsequently described by him as *Vertigo praslinensis*.

Von Martens' figures are copied, pl. 23, figs. 13-15.

Some doubt may be entertained as to whether *B. microscopica* is more than a local race of *G. seignaciana*. It differs by having somewhat larger teeth, especially the lower palatal and basal.

Specimens from Mauritius, collected by Dupont, and out of the Morelet collection, are before me. They are cinnamon-colored, fading towards the summit. Some have a weak, rounded crest behind the outer lip, others none. As in several American species, this character varies individually. The angulo-parietal lamella is of the same shape as figured for *B. seignaciana*. Lower palatal plica longer and reaching farther in, also stronger. Basal plica well developed in all specimens. Length 2.6, diam. 1.05 mm. (pl. 23, fig. 8). Length of smallest specimen 2.3 mm.

The teeth are slightly stronger than in *G. servilis*. This is apparently the form which Crosse at one time referred to his *P. lienardiana*, as the specimens in the collection from Dupont were so named. He subsequently omitted the locality Seychelles.

77. GASTROCOPTA LIENARDIANA (Crosse). Pl. 23, figs. 9, 10.

Shell perforate, oblong-ovate, smooth, thin, translucent, slightly shining, corneous. Spire terminating in an obtuse, rounded apex; suture impressed. Whorls 5, rather flat, the last a little shorter than the spire, rotund at base. Aperture subvertical, rotund-lunar, two-toothed within; peristome simple, very slightly expanded, whitish, the margins separated, converging; parietal margin having a lamelliform,

slightly bipartite tooth, columellar and basal margins each minutely one-toothed. Length 1½, diam. maj. ¾ mm. (*Crosse*).

Rodriguez: Pointe aux Coraux (A. Desmazures).

Pupa lienardiana Crosse, Journ. de Conchyl., xxi, 1873, p. 140; xxii, 1874, p. 228, pl. 8, f. 4.

The original figure (copied in fig. 10) is defective, according to Crosse, by not showing the tooth in the basal lip, nor the bifid shape of the parietal lamella. His descriptions are not consistent as to the number of teeth; it seems from the figure that there are four—angulo-parietal, columellar, basal and lower palatal. An upper palatal plica should be looked for.

In his first description Crosse gave also the locality Mauritius (E. Dupont), but later he omitted this, perhaps referring the Mauritius shells to *Pupa exigua* H. Ad.

For the present this species may be held distinct from other Mascarene forms by reason of its smaller size, comparable to the Antillean *G. pellucida*. A specimen from the Morelet collection, labeled "*P. eudeli* Desh., I. Bourbon," and received by him from Deshayes, seems to belong to this species, or near it. It is figured in pl. 23, fig. 9. The teeth are like those of *G. microscopica*, but the size is noticeably less, length 1.74, diam. 0.7, aperture, length 0.6 mm.; barely 5 whorls. The lip is slightly thickened.

77*a*. *G. lienardiana eudeli* n. subsp. Pl. 23, fig. 11.

The shell is ovate-conic, wider than *lienardiana*, the last whorl and aperture larger. Teeth substantially as in *microscopica*, the angulo-parietal having the shape shown in pl. 24, fig. 7; lower palatal strongly developed; lip somewhat thickened within. There is a very low crest behind the outer lip. Length 1.75, diam. 0.9, aperture length 0.65 mm.; 4⅓ whorls.

Island of Bourbon. No. 64091 A. N. S., ex coll. Morelet.

This form was with the shells referred above to *lienardiana*, with the label *P. eudeli* Desh., and received by Morelet from Deshayes. It is probably a distinct species, but as I have not seen topotypes of *lienardiana* it may be left in this connection for the present.

VI. Species of Ceylon, India and the Malay Peninsula.

The Indian Pupillidæ have been inadequately described and figured, and the classification of part of them remains uncertain. The original descriptions have been reprinted by Pfeiffer, and again, with useful notes on some forms, by Gude, in "The Fauna of British India." For illustrations we are dependent upon the poor figures in "Conchologia Indica," except where specimens have been supplied from the Indian Museum and other sources.

G. mimula and probably *G. serrula* belong to the typical subgenus of *Gastrocopta*, and are somewhat related to the Abyssinian *G. klunzingeri*. The slight outward bend of the inner end of the parietal lamella is a feature unusual in this subgenus.

G. bathyodon, huttoniana and *avanica* belong to the subgenus *Sinalbinula*, being closely allied to Chinese species. The species *barrakporensis* and *thibetica* may turn out to be Nesopupæ or in that vicinity. I have not seen *serrula, barrakporensis, thibetica* or *palmira*.

78. Gastrocopta mimula (Benson). Pl. 23, figs. 16, 17.

Shell rimate, ovate-oblong, subcylindrical, obliquely delicately plicatulate, pale corneous, apex obtuse, suture rather deep. Whorls 5, convex, the last slightly ascending. Aperture ovate, vertical, 5-plicate. Peristome thin, expanded, the margins joined by a thin, expanded callous. One somewhat larger, entering parietal fold, one columellar, one deeply placed basal, and two deep palatal. Length 2, diam. 1 mm. (*Bens.*).

Ceylon: Cape Pedro, among vines (Layard); Balapiti (G. Nevill).

Pupa mimula Bens., Ann. Mag. N. H. (2), xiii, 1853, p. 95. —Hanley and Theobald, Conch. Indica, 1876, p. 65, pl. 160, f. 4.—Pfr., Monographia, iv, 676.—Sowerby, Conch. Icon., xx, *Pupa*, pl. 7, f. 61. — *Pupa (Vertigo) mimula* Bens., G. Nevill, Hand List Moll. Ind. Mus., i, p. 198. — *Bifidaria mimula* Bens., Gude, Fauna Brit. Ind. Moll., ii, p. 292.

A rather narrow species, with delicate, unequal, strong

striæ at irregular intervals. It is very light buff where the dried animal does not show darkly through. No crest behind the well-expanded lip. Margins of the peristome are nearly continuous, the edge of the very short adnate part of the parietal callous being thickened. The angulo-parietal lamella is highest in the middle, where an inconspicuous callous spreads towards the columella. The angular lamella slopes regularly towards the outer lip from the high anterior end of the parietal. Near its inner end *the parietal lamella turns towards the periphery* (pl. 23, fig. 17). The strong columellar lamella is horizontal. Basal and upper palatal folds are tubercular, the lower palatal being longer and more deeply immersed, as usual in this group. Length 2.5, diam. above aperture 1 mm.

It is somewhat related to *G. klunzingeri;* also, according to Benson, to *G. serrula.*

79. GASTROCOPTA SERRULA (Benson).

Shell rimate, ovate-conic, oblong, obliquely subcostulate-striate, whitish. Spire long-conic, the apex obtuse, suture deep, crenulated. Whorls 5, the upper strongly convex, the last ascending in front. Aperture quadrate-ovate, 6-toothed: one somewhat doubled parietal lamina; 1 upper columellar and a minute lower tooth; a minute basal tooth; one upper palatal, and a deeply placed lower lamina. Peristome expanded throughout, the margins thin, joined by a wide callous above. Length 2, diam. ⅔ mm. (*Benson*).

Central India (W. Theobald).

Pupa serrula BENS., Ann. Mag. N. H. (3), xii, 1863, p. 427.—PFR., Monographia, vi, 319.—*Bifidaria serrula* BENS., Gude, Fauna Brit. Ind. Moll., ii, p. 293.

"A single derelict specimen was received from Mr. W. Theobald, jun. It approaches the Ceylon *P. mimula* B." (*Benson*). According to Gude, the type has gone astray, and no others have been found. It has not been figured.

80. GASTROCOPTA (?) BARRACKPORENSIS (Gude). Pl. 29, fig. 10.

Shell shortly rimate, cylindric-ovate, thin, very lightly striatulate, having an oily gleam, tawny-corneous. Spire with

conically-rounded apex. Whorls 5, the upper three convex, penult flatter, last whorl forming one-third the length, compressed basally, having two pits forward. Aperture slightly oblique, oblong, narrowed by 4 teeth: one pliciform parietal, one columellar, two deep, short palatals. Peristome whitish, shortly expanded. Length 2, diam. 1 mm. (*Pfr.*).

India: Barrackpore.

Pupa indica PFR., P. Z. S., 1854, p. 295; Mon. Hel. Viv., iv, 1859, p. 679. — HANLEY and THEOBALD, Conch. Indica, pl. 160, f. 8. — SOWERBY, Conch. Icon., *Pupa*, pl. 7, f. 63. Not *Pupa indica* Benson, 1849. — *Pupilla barrackporensis* GUDE, Fauna Brit. India, Moll., ii, 1914, p. 285.

The generic position is uncertain. I have not seen specimens.

81. GASTROCOPTA BATHYODON (Benson). Pl. 26, fig. 14; pl. 29, fig. 8.

Shell deeply rimate-perforate, ovate-conic, obliquely striatulate, brown-corneous, translucent. Spire conic, the apex obtuse, suture rather deep; whorls 5, convex, the last ascending in front, a little compressed around the excavated umbilicus. Aperture square-ovate, margins expanded, somewhat reflected, of the color of the shell, joined above by an expanded parietal callous, 4-toothed: one entering, larger parietal, two minute, rather remote palatals, and one deeply placed columellar. Length 3, diam. 2 mm. (*Benson*).

India: Teluk Sendur, near Hoshungabad, not far from the Nerbudda River; also Mul River, western India (Theobald).

Pupa bathyodon BENS., Ann. Mag. N. H. (3), xii, 1863, p. 426. — HANLEY and THEOBALD, Conch. Indica, 1874, pl. 100, f. 7.—SOWERBY, Conch. Icon., xx, 1876, *Pupa*, pl. 4, f. 33; pl. 16, f. 152. — *Bifidaria bathyodon* Benson, GUDE, Fauna of British India, Mollusca, ii, 1914, p. 290.

The figures in Conchologia Indica and C. Iconica show a fifth tooth, the basal fold, at the base of the columella. It is present also in a specimen (pl. 26, fig. 14) in the Indian Museum, from the Nerbudda Valley, collected by W. Theobald (Nevill, Handlist Moll. Ind. Mus., p. 192). The angular and

parietal lamellæ form one continuous lamella, as seen from the base, the angular projecting slightly at their junction. The columellar lamella enters horizontally. The peristome is continuous and forms a raised ledge across the parietal wall. This peculiarity, together with the conic shape, gives the shell much the aspect of *Boysidia;* but as the columellar lamella does not descend inwardly, and the basal fold is subcolumellar in position, it is nearer the subgenus *Sinalbinula*, in *Gastrocopta*, though in some degree transitional. Length 3.35, diam. above aperture 1.65 mm.; 5 whorls.

82. GASTROCOPTA HUTTONIANA (Benson). Pl. 21, figs. 15, 16, 17.

Shell rimate, ovate-oblong, subcylindrical, hyaline, glossy, the apex obtuse. Whorls 5, convex. Aperture ovate-rotund, 5-plicate. Peristome a little expanded, the margins joined by a thin callous. One irregular, sinuous parietal fold, two columellars, and two deeply-placed palatals. Length 1½, width scarcely 1 mm. (*Benson*).

India: Simla, type loc. (Hutton); Sind (Blanford); Kashmir and Deccan (Stoliczka); Ahmednuggar (Theobald); Wadale (Fairbank); Panjal Range, Kashmir (Theobald); Jhelum Valley (Godwin-Austen).

Pupa huttoniana BENS., Ann. Mag. N. H. (2), iv, 1849, p. 126.—HANLEY and THEOBALD, Conch. Indica, 1875, pl. 101, f. 3.—THEOBALD, Journ. As. Soc. Bengal, xlvii, 1878, p. 146.—PFEIFFER, Monogr. Hel. Viv., iii, 550; iv, 676; vi, 321.—GODWIN-AUSTEN, Proc. Malac. Soc. London, iii, 262. — *Bifidaria huttoniana* Bens., GUDE, Fauna Brit. Ind., Moll. ii, p. 291.—*Carychium boysianum* Benson MS., NEVILL, Hand List Moll. Ind. Mus., i, 1878, p. 197.

This species is very close to *G. armigerella* of China and Japan, but is distinct by the *smaller size*, absence of a suprapalatal plica, very small or wanting infraparietal tubercle, and the larger columellar lamella. The figure of a Simla specimen is copied from Conchologia Indica (pl. 21, fig. 17). I have not seen topotypes, those figured (pl. 21, figs. 15, 16) being from Kashmir, coll. Theobald. The angulo-parietal

lamella is strongly bifid in a front view. Though both lamellæ are completely concrescent, the parietal stands obliquely to the angular, and there is a depression or saddle where they meet. The angular extends to the lip. There is a very low infraparietal in some examples, but not in that figured. The columellar lamella is stout and horizontal, deeply entering. The basal fold is subcolumellar in position, a low, broad nodule, but sometimes higher than in the individual figured. The lower palatal plica is compressed, the upper wide and blunt. Length 1.9, diam. above aperture 1.1 mm.; 5 whorls.

83. GASTROCOPTA (?) THIBETICA (Benson).

Shell rimate-subperforate, oblong-ovate, smooth, translucent, glossy; spire ovate, apex obtuse, suture impressed. Whorls 5, subconvex, the last ascending in front. Aperture obovate, 6-plicate: one angular fold on the parietal wall, followed by a deeply placed inferior one; two columellar teeth and two deeply placed palatals. Peristome thin, a little expanded, the columellar margin reflected a little. Length 2, diam. 1 mm. (*Benson*).

Thibet: Iskardo (Dr. Thomson).

Pupa thibetica BENS., Ann. Mag. N. H. (3), xiii, 1864, p. 138.

"Nearly allied to *P. huttoniana* Bens., to which I erroneously referred it originally; but on close examination perfect specimens exhibit two parietal plaits, one of which is remotely seated, and in some positions is not easily detected" (*Benson*). This species has not been figured. *G. huttoniana* sometimes has a low, nodular, infraparietal lamella.

84. GASTROCOPTA AVANICA (Benson). Pl. 29, fig. 9; pl. 26, fig. 11.

Shell umbilicate, ovate-oblong, subcylindrical, scarcely striatulate, glossy, brownish-corneous, translucent. Spire oblong, conical towards the obtuse apex; the suture deeply impressed. Whorls 5½, subconvex, the last ascending in front. Aperture ovate, obtuse above, 6-toothed: one entering, duplicate parietal fold; two deeply placed columellar teeth, and three deeply placed palatals. Peristome expanded throughout, the

margins thin, joined by a wide parietal callous. Length 2½, diam. 1⅓ mm. (*Benson*).

Burma: region of Ava (W. T. Blanford); also Mandalay (Blanford).

Pupa avanica Bens., Ann. Mag. N. H. (3), xii, 1863, p. 428.—Blanford, Journ. A. S. Beng., vol. 34, 1865, p. 95.—Hanley and Theobald, Conch. Indica, 1876, pl. 160, f. 7.—Sowerby, Conch. Icon., xx, *Pupa*, pl. 7, f. 60.—*Bifidaria avanica* Bens., Gude, Fauna Brit. Ind., Moll. ii, p. 292.

"This shell is related to the Western Himalayan *P. huttoniana* Bens., but differs in surface, in having an additional upper palatal tooth, and a more distinctly double parietal plica" (*Bens.*). Fig. 9 is copied from Conchologia Indica.

"The species is characterized by the very convex whorls and the deep suture, resembling *mimula* in that respect, but it is more conoid and the last whorl becomes more contracted, while in *mimula* the aperture is more rotundate. A specimen in the Hungerford collection in the British Museum shows a slight additional parietal denticle nearer the columella. A shell in the Beddome collection has only two palatal plicæ" (*Gude*).

An Ava specimen from the Indian Museum is drawn in pl. 26, fig. 11. The shape is a little more conic and the suture deeper than in *G. huttoniana*. The inner end of the angular and the outer end of the parietal lamella are juxtaposed laterally and concrescent, the parietal being much higher than in specimens of *huttoniana* seen. There is a slight trace of an infraparietal. The columellar lamella enters horizontally. Basal fold is subcolumellar in position. There are but two stout palatal plicæ. The peristome is continuous. Length 2.2, diam. above aperture 1.15 mm.; 5¼ whorls.

85. Gastrocopta palmira (Stoliczka). Pl. 25, figs. 4, 9.

Shell ovate-cylindric, rimate, dull whitish, corneous, apex rather obtuse. Whorls 5, convex, gradually increasing, joined by a simple suture, rather smooth, nearly polished, marked with a few transverse, oblique lines of growth. Aperture nearly vertical, subquadrangular, 5-toothed within, whitish;

lip a little expanded throughout, and slightly thickened, sinuous outwardly below the suture, bidentate deep within, the upper tooth smaller, at the base having a single minute tooth, and in the middle of the columella another stronger one; labium thin, adnate, provided with a bipartite, lamelliform tooth above the middle, near the posterior angle. Length 2.15, diam. 1, length of aperture 0.8, width 0.6 mm. (*Stol.*).

Malay Peninsula: Penang and in the Wellesley Province, under the bark of *Cocos nucifera*.

Pupa (Scopelophila) palmira STOL., Journ. Asiatic Soc. Bengal, xlii, pt. 2, 1873, p. 32, pl. 3, f. 3*a*, *b*.

"This is of exactly the same type as the Arrakanese *P. filosa*, described at p. 333 of the Journal for last year, but it is larger, more cylindrical, and has one tooth more in the aperture. From *P. avanica* it differs by less closely wound whorls, and by the internal dentition of the aperture. It appears to be a very rare species. I found one specimen under the bark of a cocoanut tree on Penang, and two others on the opposite coast, in the Wellesley Province" (*Stoliczka*).

I have not seen this species, which has been referred by von Moellendorff to *Boysidia* (Proc. Zool. Soc. Lond., 1891, 337), but he had not seen specimens. *P. filosa*, which Stoliczka compares, certainly belongs to the *Nesopupa* group. Before seeing specimens of *filosa* I had copied the figures on pl. 25, figs. 10, 11.

VII. SPECIES OF THE PHILIPPINES, EAST INDIES, MICRONESIA, MELANESIA, POLYNESIA AND HAWAII.

The subgeneric positions of *G. capillacea*, *G. microsoma* and *G. neocaledonica* are uncertain. *G. lyonsiana* belongs to the typical group of *Gastrocopta*. All of the rest belong to the subgenus *Sinalbinula*, and, with the exception of *G. moellendorffiana*, their affinities are with Australian species.

Adaptability to life around habitations has, no doubt, led to the vast Polynesian distribution of *G. pediculus*. I infer that it has been carried from island to island, sticking to native impedimenta, cocoanuts, or other food materials, in the thousand years or more of inter-island canoe voyages of the Poly-

nesians. Its original habitat may have been somewhere between the Philippines and New Caledonia. The Pupillid fauna of the islands between these extremes is but little known as yet.

There is some evidence that *G. lyonsiana* and *pediculus* in the Hawaiian group are immigrants since the period of human occupation. Neither has been found in the Pleistocene deposits, where native Pupillidæ are abundant. This is negative evidence; yet since the Gastrocoptas inhabit the lower levels, are generally spread in Oahu, and are often so abundant that one can collect hundreds in a few minutes, their absence from such deposits as that at Diamond Head and the sands at Kahuku becomes significant. The Hawaiian species both resemble Philippine forms closely, but the local race of *pediculus* can also be matched exactly by individuals from many Polynesian islands.

Leucochilus euryomphalum Moellendorff (Abhandlungen Naturforsch. Ges. Görlitz, xxii, 1898, p. 153) from Tangat, Busuanga, has not been described so far as I know.

Pupa pfeifferi Boettger, stated to be from Pitcairn Island, on the authority of Cuming, is not a Polynesian shell, in my opinion, being identical with *Gastrocopta munita* (Reibisch), of the Galapagos Islands. See p. 96.

86. Gastrocopta lyonsiana (Ancey). Pl. 24, figs. 1 to 4.

Shell dextral, glossy, obliquely striatulate under a strong lens, oblong, subcylindric, obliquely rimate-perforate, thin, bright corneous. Spire more or less slender, subcylindric, tapering at the obtuse summit; whorls 5 to 5¼, convex, regularly increasing; suture impressed, the last whorl somewhat tapering, hardly constricted. Aperture truncate-oval, lamellate as follows: one parietal arising at the margin, but hardly noticeable there, then suddenly becoming upright, strong and slightly sinuous; one columellar lamella simple, appearing like an acute tooth; two drop-shaped palatals, the first smaller, second elongated, a little more remote from the margin. Peristome expanded, scarcely thickened, dilated at the columellar margin. Length 2⅓, diam. 1 mm. (*Ancey*).

Hawaiian Is., Oahu: Punahu, a suburb of Honolulu, type loc.; Manoa Valley; also throughout most of the lower zone of the island. Also Philippines.

Pupa lyonsiana ANCEY, Mémoires de la Société Zoologique de France, v, 1892, p. 713; Proc. Malac. Soc. London, vi, 1904, p. 126.—*Leucochilus artense* (Montr.) MOELLENDORFF, Bericht Senckenb. Nat. Ges., 1893, p. 100, with var. *cornea* Bttgr.; Verzeichnis, 1898, p. 127, with mut. *cornea* Bttg.

The several forms of *lyonsiana* and *cornea* approach the Antillean *G. servilis* and its Brazilian variety *oblonga* so closely that I have very little doubt that they are specifically identical, the forms from Oahu, Guam and the Philippines probably being the descendants of Antillean or Brazilian snails imported on plants. While most of the Oahuan snails show some slight variation not exactly matched in American specimens examined (the shell being longer, with the spire perceptibly more slenderly tapering), yet a large proportion of them seem to me to be indistinguishable. Moreover, we may not have *servilis* from the exact locality which supplied the imported examples. Under these circumstances, *G. lyonsiana* is admitted as a species with considerable reserve.

G. seignaciana (Crosse), of Nossi-bé, also is extremely similar to Philippine and Hawaiian specimens.

The typical form, from Kualii, Manoa Valley, near the type locality, is drawn in pl. 24, figs. 1, 2. The color of shells taken alive is cinnamon or a little paler, and transparent enough to show the dried animal darkly through; lip of the same color. The shell is generally quite long, with small aperture, but others in the same lot are shorter, with the proportions of *G. servilis*. The spire is narrower in the upper part than in most species of the group, the taper being almost regular in some examples. Other specimens are slightly swollen in the upper part, and more cylindric. The angulo-parietal lamella has a small lobe in the middle, where the two lamellæ unite. There is no trace of the anterior end of the parietal on the columellar side, the concrescence being complete. The parietal portion is nearly straight.

The columellar lamella is very short and horizontal.

The upper palatal plica is tuberculiform, small, the lower lengthened. There is no basal plica, or in some specimens a slight thickening may be made out with difficulty.

The figured specimens measure 2.4 x 1 mm. (fig. 1) and 2.6 x 1 mm. (fig. 2).

Specimens from the "coral bluff" west of Kahuku, at the northwest end of Oahu, are typical. The smallest measured is 2.2 mm. long, 0.95 diam.; others being up to 2.65 mm. long. Several thousand were collected there in a few minutes, in the surface debris.

The shells from the hotel grounds, Haleiwa, on the west coast, and those from the bluff at Kawaihapai, near the southwest point of Oahu, differ by the reduced size of the upper palatal, which is extremely small in some, wholly wanting in most of the specimens. The size varies from typical to a smaller, short-whorled form, one of which from Kawaihapai is figured (pl. 24, fig. 4, 2.35 mm. long).

Specimens taken in a very arid place on the railroad above Watertown, East Loch of Pearl Harbor, average small, with the palatal plicæ small, upper and basal minute, subequal, the lower palatal short (pl. 24, fig. 3).

Form *kailuana*. Pl. 24, figs. 5, 6. On the north (Koolau or windward) side of Oahu, at Kaelepulu, Kailua, it was found in copious quantity on old reef rocks not far inland. Here there is a tubercular basal fold distinctly developed, often larger than the upper palatal, which in some specimens is very small or even wanting. In size they do not differ from the Manoa and Kahuku shells.

Philippine Records. — Dr. von Moellendorff (1893) states that Professor Boettger communicated to him the opinion that he would retain *Pupa artensis* Montr. as a species distinct from *pediculus* on account of its slimmer, nearly cylindric shape. "Besides, in New Caledonia the glossy-clear type occurs; also on Luzon, where my friend O. Hennig found it on the cliffs Peña blanca, Province Cagayan." In his *Verzeichniss*, 1898, he gives the localities "Cebu, Bohol, Luzon, etc." In my opinion, the shells in question are not really *artensis*, but a form of *lyonsiana*.

"*Leucochilus artense* (Montr.), mut. *cornea* Bttgr. *in litt.*," Moellendorff, 1893, is described as follows: "The variety is horn-brown, and as a rule still more slender than the type." He gives the localities, Leyte, Iba near Malitbog, Liloan on Panaon, Limansaua (Quadras). Also on Cebu (Koch) and near Balinag, Prov. Bulacan (Quadras and Mlldff.), Majayjay, Prov. Laguna (Mlldff.).

Specimens from the Quadras collection labeled *L. artense cornea*, doubtless determined by von Moellendorff, are from Bisucay, Calamianes (pl. 24, figs. 7, 11) and Apapa, Guam. These agree absolutely with the Oahuan form of *G. lyonsiana* from Kailua, as all of them have the small basal fold developed. The angulo-parietal lamella is slightly more sinuous than in the Manoa Valley *lyonsiana*. The length varies from 2.35 to 2.7 mm.

87. GASTROCOPTA CAPILLACEA (Dohrn et Semper).

Shell rimate, ovate-conic, thin, pellucid, obliquely marked with hair-like striæ, corneous. Suture impressed, simple. Whorls 5½, convex, the last slightly ascending in front, somewhat compressed at the base. Aperture vertical, contracted by 4 or 5 teeth; one strongly sinuous parietal; one transverse, lamelliform columellar; one punctiform basal, and 1 or 2 deeply placed palatals, the lower strong, upper very small or disappearing; peristome a little expanded, the columellar margin widely reflected. Length 3½, width 1¼, width of aperture ⅔ mm. (*D.* & *S.*).

Philippines: Masoloc, in the island of Mindanao (Dr. C. Semper).

Pupa capillacea DOHRN et SEMPER, Malakozool. Blaetter, ix, 1862, p. 207.—PFEIFFER, Monogr. Hel. Viv., vi, 320.

The type of *capillacea* has not been figured. According to the dimensions given, its shape should be highly characteristic, the diameter contained 2.6 times in the length — somewhat narrower than the most lengthened *G. strangei*. It is also larger than any other species of the region. It is likely, however, that the dimensions were not measured exactly. I have found the limit of error to be very high in many measurements of minute shells.

88. GASTROCOPTA MOELLENDORFFIANA n. sp. Pl. 24, figs. 8, 12, 13.

The shell is ovate, perforate and rimate, grayish white, slightly transparent, composed of 4½ strongly convex whorls. The aperture is rounded, a little longer than wide, obstructed by 7 or 8 teeth. The angular lamella is sigmoid, subparallel to the anterior part of the parietal, a callous deposit between them. The parietal lamella is higher, little curved, and joined by the angular lamella behind the middle. The infraparietal is a well-developed, slightly oblong tubercle. The columellar lamella is horizontal in front, and curves downward within. The lower palatal plica is a strong entering fold. Upper palatal is nearly as long, and is placed obliquely, the inner end approaching the lower palatal. There is a tubercular suprapalatal plica, minute in some examples. The basal fold is nearly transverse to the cavity, and subcolumellar in position. Palatal callous scarcely noticeable. The peristome is thin, broadly expanded, continuous or nearly continuous across the parietal margin. Length 2, diam. above aperture 0.95 mm.

Philippines (J. B. Steere); Sierra Bullones, Bohol (Quadras).

By the downwardly turned columellar lamella and strongly developed parietal armature this species is related to Japanese forms. The teeth are quite unlike any species described from the Philippine or more southern islands, with the exception of *G. hedleyi*, in which the downward extension of the columellar lamella is much more developed, and the upper palatal plica less oblique.

89. GASTROCOPTA PEDICULUS (Shuttleworth). Pl. 25, figs. 1-3, 5-8, 12-15.

Shell minute, ovate-oblong, thin, slightly striatulate, pellucid, hyaline. Spire obtuse; whorls 6, convex, the last slightly compressed at the base; suture deep. Aperture rounded-subauriform, 5-plicate: angular fold strong, flexuous, immersed and somewhat emarginate in front; one rather strong columellar; three immersed palatals, the middle one stronger.

Peristome thin, narrowly expanded, the right margin roundly curved above, the middle part nearly parallel with the columellar border. Diam. 1¼, alt. 2½ mm.; aperture scarcely 1 mm. long (*Shuttl.*).

Melanesia, the coast of New South Wales, Polynesia, Micronesia, Philippines and Hawaii. New Caledonia: Anse Vata (Dupuy) and Art Island (Montrouzier). Fiji group: Kanathia and Oneata (Graeffe). Samoan group: Tutuila, Upolu (Graeffe). Tonga group: Niuafu, Haafeva. Hapai group: Tongatabu (Graeffe). Austral Is.: Rurutu (Garrett). Hervey group: Raratonga (Graeffe, Garrett), Mauiki (C. D. Voy). Society Is.: Tahiti (Verreaux, Garrett), Huahine (Garrett), Tahaa, Raiatea (Godeffroy exp.). Marquesas (Verreaux, Voy, Garrett). Ellice Is.: Funafuti (Graeffe, Hedley), Vai-tupi, Niutao (Graeffe). Gilbert Is. (Pease). Marshall Is.: Ebon (Garrett). Caroline Is.: Yap (Kubary). Marianne Is.: Guam (Quadras).

Pupa pediculus SHUTTL., Mittheilungen der naturforschenden Gesellschaft in Bern, 1852, p. 296. — PFEIFFER, Monographia Hel. Viv., iii, 557.—BOETTGER, in von Martens, Conchologische Mittheilungen, i, 1881, p. 65.—*Vertigo pediculus* Shuttlw., GARRETT, Proc. A. N. S. Phila., 1879, p. 19 (Rurutu, Austral Is.; also Tahiti, Cook's Is., Viti Is.); Journ. A. N. S. Phila., viii, 1881, p. 400 (Rarotonga, Hervey group); J. A. N. S. Phila., ix, p. 83, pl. 3, f. 42 (Society Is.); Bull. Soc. Malac. France, iv, 1887, p. 32 (Marquesas).—HEDLEY, Mem. Australian Mus., iii, pt. 7, 1899, p. 488 (Funafuti, Ellice Is.). —MELVILL & STANDEN, Journ. of Conch., viii, p. 88 (Lifu).—*Leucochila pediculus* (Shuttl.) MOELLENDORFF, Journ. of Malac., vii, 1900, p. 113 (Yap, Carolines; also Mariannes and Philippines). — *Vertigo pediculus* var. *samoensis* MOUSSON, Journ. de Conchyl., 1865, p. 175 (Upolu); 1869, p. 341 (Upolu and Tutuila); 1873, p. 106 (Funafuti, Vai-tupu, Nukufetau, Niutao and Nui, Ellice group).—*Pupa pediculus* var. *samoensis* MOUSSON, Journ. de Conch., 1870, p. 127 (Kanathia and Oneata, Fiji group); 1871, p. 15 (Niuafu, Hufeva on Hapai, Tongatabu, Tonga group).—*Pupa samoensis* Mss., SCHMELTZ, Catal. Mus. Godeffroy, iv, p. 69.—*Vertigo nitens* PEASE, Proc.

Zool. Soc. Lond., 1860, p. 439 (Ebon Is.). — *Pupa hyalina* Zelebor, in Pfeiffer's Monographia Heliceorum Viventium, vi, 1868, p. 329.—*Vertigo nacca* Gould, Proc. Boston Soc. N. H., 1862, p. 280; Otia Conch., p. 237 (Hawaii).—*Bifidaria pediculus* var. *nacca* Gld., Ancey, Proc. Malac. Soc. London, vi, 1904, p. 126 (Waipio Valley, Hawaii). — *Pupa artensis* Montrouzier, Journ. de Conchyl., vii, 1859, p. 288, pl. 8, f. 4. Crosse, J. de C., 1894, p. 301.—*Pupa (Vertigo) rossiteri* Brazier, Proc. Linn. Soc. N. S. Wales, i, 1877, p. 18.

The Marquesas shells may be taken as the types. Pl. 25, figs. 1, 2, 3 represent specimens collected by C. D. Voy in the Marquesas, exact island not stated. The parietal and angular lamellæ are separate and parallel anteriorly, the angular being sigmoid, and high where it joins the parietal; the parietal is somewhat curved, the concavity of the curve being towards the columella (fig. 2). In a front view, the parietal lamella is seen to lean towards the columella. In some examples there is an extremely low, scarcely noticeable infraparietal nodule, in others none. The columellar lamella is stout, short and horizontal. From its inner end a *very low* callous ascends, obliquely receding, on the axis. The lower palatal plica is rather long and strong; the upper is shorter and converges a little towards the lower, inwardly. The basal plica is much smaller, tubercular, and set rather deeply. The palatal callous is rather diffuse and indistinct. Length 2.6, diam. above aperture 1.3 mm.

A more slender specimen in the same lot is drawn in pl. 25, fig. 3. The angular lamella is more closely joined to the parietal than in the typical form.

The most conspicuous variation is in the basal plica, which may be well developed, minute, or wholly wanting among specimens of the same lot, in the Society, Samoa, Hervey, Fiji and other groups; yet in Polynesia it is absent in a minority of examples in every case, so far as I know. In the varieties from the Philippines and Hawaii the basal fold seems to be always absent or quite minute.

The infraparietal tubercle is also found in a minority of the specimens, but I have noted its presence in localities as

far apart as the Marquesas and New Caledonia, always associated in lots with specimens lacking it.

A more important variation, probably, is the position of the basal fold. In some lots (pl. 25, figs. 5, 8) among which I may mention the Society Is., Hervey Is., Samoa, Guam, New Caledonia, the basal is rather large and decidedly subcolumellar in position, being nearer the columellar lamella than in the typical *pediculus*.

The angulo-parietal varies among specimens of the same lot in degree of concrescence of the two lamellæ and height of the angular. The variation of this tooth is perhaps greater than in any other species of the genus.

Range and Station.—The distribution of *pediculus* in Polynesia is known chiefly by the work of Dr. Ed. Graeffe, collecting for the Godeffroy firm, whose material was reported on by Mousson and Boettger, and by the collections of Andrew Garrett. Sixteen lots in the collection of the Academy fairly cover the distribution of the species, extreme points being Port Jackson, New Caledonia, Marquesas, Oahu, Guam and Bohol. For notes on the Australian forms, see p. 158.

It has been found on nearly every inhabited atoll and high island of Polynesia, Micronesia and Melanesia where small land shells have been looked for. On the high islands it occurs in the lower zone, probably never in the high mountain forests. Andrew Garrett reports that he "found them in vast numbers on stony ground in a grove near the seashore, but comparatively rare in the mountain ravines" of Cook's Islands. The Hawaiian form was found abundantly on the coastal border and in the lower parts of the valleys, but not in any of my gatherings from high ridges. It lives on stones, garden walls, or under wood, leaves and the like, in somewhat shaded places. On Tongatabu Dr. Graeffe found it especially among the stems of small plants which cover the coral reefs of the southern coast. Montrouzier reports it from Art Island under leaves and sprouting cocoanuts.

Since the following races have been named, they are recognized here, though their differential characters are slight.

G. p. ovatula (Moellendorff). Pl. 25, figs. 13, 15.

It differs from the type by the regularly ovate shell, less lengthened, and a little smaller. Alt. 2⅛, diam. max. 1⅓ mm.

Philippines: Cebu, at the town of Guadalupe. Also Siquijor, Mindanao, Leyte, Bohol, Luzon, etc., and Yap, Caroline Is. (*Mlldff.*).

Leucochilus pediculus var. *ovatula* Boettger, Moellendorff, Bericht Senckenb. naturforsch. Ges. Frankfurt, 1890, p. 253; 1893, p. 100. Verzeichniss, etc., p. 127, in Abhandl. naturforsch. Ges. zu Görlitz, xxii, 1898, p. 153; Journ. of Malacol., vii, p. 113.

"Different from the Polynesian type only by the shorter, more compact form; the examples are 5-toothed, the parietal tooth distinctly bifid, the basal tooth very weak. The same variety, wholly agreeing in size, shape and dentition, occurs also on the islands Siquijor and Mindanao, as well as upon Yap, Carolines.

"'*Pupa capillacea*' of Hidalgo, J. de Conch., 1888, p. 38, from Naga, Cebu, is certainly not the species described by Dohrn and Semper from Mindanao, but most likely the above-described variety of *L. pediculus*" (*Mlldff.*).

The Bohol specimens figured (pl. 25, figs. 13, Loboc, and 15, Sierra Bullones, Bohol) were received from Quadras under the above name. The shape seems rather variable, both lots having shorter and larger examples, but all agree in the very small size, or absence, of the basal fold. This is also characteristic of the Hawaiian race, and of that inhabiting the coast of Queensland.

G. p. nacca (Gould). Pl. 25, figs. 6, 7.

The teeth are a little smaller than in typical *pediculus*, the parietal lamella shorter, and the basal either wanting or very small. The upper palatal plica is short, and there is often a small interpalatal plica below and near it. Infraparietal nodule *very small* or wanting. It is often somewhat narrower than the examples figured. Length 2.6, diam. 1.3 mm. (fig. 6).

Hawaiian Is.: Hawaii (Dr. Newcomb), Waipio Valley (Thaanum). Oahu: Manoa Valley (figs. 6, 7) and west of Kahuku (Pilsbry and Cooke).

There is an average difference between Hawaiian and Polynesian specimens, though individuals not distinguishable from those of Oahu may be found in almost any large lot from the southern islands. By the invariable reduction of the basal fold, the Hawaiian race resembles the Philippine variety closely. The occasional presence of an interpalatal plica I have noticed also among *pediculus* from the Society Islands and other places. Gould's original description follows.

Vertigo nacca. Shell ovate, lucid, alabastrine, very delicately striate. Whorls more than 4, ventricose; apex obtuse; suture deep; aperture subcircular, armed with a palatal tooth (sometimes bifid), a columellar tooth, a basal tooth and a labial tooth. Peristome strongly reflected, umbilicus rimate. Axis $^1/_{10}$, diam. $^1/_{12}$ inch. Hab. Hawaii, *Dr. Newcomb.* The denticles are similar to those of *V. gouldii* and *V. tantilla.* The latter is smaller, has a rugose surface, and one more denticle (*Gould*).

The original descriptions of species considered synonyms of *G. pediculus* follow.

Pupa artensis (pl. 25, figs. 5, 8, 14). Shell broadly umbilicate, cylindric-conic, of a corneous-white color, a little shining, transparent and smooth, but very fine, oblique, growth-striæ may be noticed. Spire conic, gradually tapering, composed of 5 very convex whorls, separated by a deeply impressed suture, the last whorl ventricose and compressed at the base. Aperture somewhat rounded; peristome thin, reflected; the upper end of the right margin curved abruptly towards the axis of the shell, to join the left margin, and forming a continuous peristome. Interior provided with 5 teeth, one parietal, one columellar and three palatals; the parietal, situated near the right side, is grooved above and bifid at the point; this formation is in consequence of its being formed of two unequal teeth juxtaposed, the inner one being more prominent. The columellar tooth is placed transversely in the aperture, and perpendicular to the columella. Of the three parietal [error for palatal] teeth, the point of the upper one corresponds to the bifurcation of the parietal; the next one is almost directly opposite the internal portion of the parietal; while the third is in the middle of the space between the columellar and second parietal [error for palatal]. Of the 5 teeth, the parietal, columellar and second palatal are the most prominent. Length 2, width 1 mm.

New Caledonian archipelago: Art Island, under leaves and cocoanuts (coll. Montrouzier, and in the Bordeaux Mus.).

The original figure is copied in fig. 14. Several lots seen. The basal fold is generally rather large and subcolumellar in position, but in some of the individuals from Anse Vata, New Caledonia, it is small and has a more basal position, as in typical *pediculus*. An infraparietal nodule occasionally is seen. *P. artensis* is exactly the form named var. *samoensis* by Mousson.

"Var. *samoensis* Mousson. A little conoid, subhyaline, the parietal tooth thinner, subduplicate, sometimes having a sixth minute tooth between the columellar and the parietal. Upolu, Samoa Is. Graeffe.

"The type lives on the Marquesas Islands. This variety is a thought more conic, more crystalline, in consequence of the constant loss of the epidermis. The teeth, 5 in number, have the same arrangement, three on the palate, of which the middle one is strongest, one large one on the columella, and finally a more elevated, doubled one on the wall of the preceding whorl. In some individuals a sixth little tooth also may be seen on the same margin, between the columellar and the principal teeth. These differences seem to me entirely within the limits of a single species" (*Mousson*).

Having seen many specimens from the localities given by Mousson, including some collected by Dr. Graeffe, I agree with Boettger that it is *pediculus*. The form is that with the basal fold subcolumellar in position, as in *artensis*. A topotype is figured, pl. 25, fig. 12.

"*Vertigo nitens*. Shell cylindrically oval, thin, pellucid, imperforate, apex; whorls five, rounded; sutures impressed; aperture subquadrate, rounded at the corners; lip slightly expanded and reflexed, furnished internally with three teeth, about equal distances apart, one of larger size, and bipartite on centre of columella, and one at the base. Colour white" (*Pease*).

Marshall group: Ebon Island. Specimens I have seen from Ebon, received from Pease, are typical *pediculus*. Pease himself seems to have doubted the distinctness of his species, from his remark in Proc. Zool. Soc., 1871, p. 463. Garrett

writes: "I obtained Mr. Pease's type specimen of *nitens* at Ebon, a low coral island in the Caroline or Marshall group. When he described that species he was not aware that Mr. Shuttleworth had anticipated him in his *pediculus*, described from Tahitian and Marquesian examples" (Proc. A. N. S. Phila., 1879, 20).

Pupa hyalina. Shell dextrally wound, ovate, minute, umbilical chink deep, striæ scarcely visible, a little shining, pellucid, dirty white. Spire narrowing from the last whorl, apex obtuse. Whorls 4 or 5, strongly convex, joined by a deep suture, the last compressed below, at base rounded carinate. Aperture rather large, truncate-ovate, contracted by 5 white, dentiform folds: two in the radius, one anterior, lamelliform, bipartite, running to the parietal margin; two in the palate, the lower one at the base; margins of the aperture broadly separated above, strongly reflected, white-calloused within. Alt. 2⅓, diam. 1⅛ mm. Habitat in insula Taheiti (*Zelebor*).

The above description agrees well with *pediculus*. Specimens of that species from Tahiti seen by Shuttleworth, Boettger, Garrett and the writer do not differ from Marquesan examples.

90. GASTROCOPTA MICROSOMA (Tapperone-Canefri). Pl. 24, fig. 9.

Shell very minute, openly rimate, obliquely substriate, thin, pellucid, pale corneous. Spire cylindric-conic, the apex obtuse. Whorls 5, convex and separated by a deep suture, the last subcompressed behind the aperture. Aperture quadrate-rounded, about one-third the total length of the shell. Peristome interrupted, a little expanded and subreflected throughout. Apertural laminæ 4: angular subimmersed and bifid; columella rather strong; two inconspicuous palatals. Length 2½, diam. 1 mm. (*T.-C.*).

Aru Is.: Wokan (Beccari).

Pupa microsoma TAPP. CAN., Ann. Mus. Civ. Stor. Nat. Genova, xix, 1883, p. 107, pl. 2, f. 1, 2.

The rather indefinite figure, which is copied on my plate, suggests the *servilis* group; but in the absence of specimens I cannot decide upon its affinities.

91. GASTROCOPTA RECONDITA (Tapperone-Canefri). Pl. 24, fig. 10.

Shell very minutely rimate, ovate-oblong, longitudinally obliquely substriate, thin, glossy, pellucid. Spire cylindric-conic, the apex obtuse. Whorls 5, slightly convex, parted by a deep suture, the last whorl compressed behind the aperture, one-third the total length. Aperture rounded subquadrate, dilated above. Peristome continuous, thin, somewhat reflected throughout. Apertural laminæ 5 or 6: an angular generally joined to the peristome; parietal convex, subimmersed; columellar strong; palatals 2 or 3, the lowest smaller, rarely obsolete, the upper a little thickened. Alt. 2⅓, diam. 1¼ mm. (*T.-C.*).

Aru Is.: Wokan (Beccari). Moluccas: Hulaliu, Haruku; Banda (Strubell).

Pupa recondita TAPPARONE-CANEFRI, Annali del Museo Civico di Storia Naturale di Genova, xix, 1883, p. 106, pl. 2, f. 3, 4.—*Leucochilus reconditum* (Tapp.-Can.) BOETTGER, Bericht über die Senckenbergische Naturforschende Ges. in Frankfurt a. M., 1891, p. 270.

From the description and figure, this seems to be closely related to *G. pediculus*, but the angular and parietal lamellæ appear to be more separated, as in *G. moellendorffiana*.

In comparing with specimens of the original lot from Wokan, Professor Boettger noticed a few differences in those from the Moluccas. In the Aru type, the right twin-lamella of the parietal wall reaches almost to the peristome, but in the Haruku form not so far forward, and the two teeth on the columella seem pushed a little nearer together than in the type. Also the umbilical perforation is a little more distinctly developed. Alt. 2.2, diam. max. 1.25 mm. The Banda examples are distinguished by a less distinctly twinned structure of the parietal lamella, in a front view.

92. GASTROCOPTA NIOBE (Fulton). Pl. 24, fig. 15.

"Shell elongate-oval, rimate, smooth, dirty white; whorls 5, convex. Peristome oval, thin, continuous, expanded; internal armature of the aperture consists of five plaits: two

rather long entering folds on the parietal wall, one on the columellar side, and two on the basal portion of the aperture. Diam. maj. 1, alt. 2 mm." (*Fulton*).

Tenimber Island.

Pupa (Leucochilus) niobe FULTON, Proc. Malac. Soc. London, iii, March, 1899, p. 216, pl. 11, f. 10.

"This has kindly been compared by Dr. von Möllendorff, who says that the species has some affinity with *P. recondita* Tapp.-Can., from the Aru Islands, but is smaller and more cylindrical in form" (*Fulton*).

93. GASTROCOPTA NEOCALEDONICA n. n. Pl. 24, fig. 14.

Shell dextral, very minute, nearly covered rimate, ovate-conic, very delicately diagonally striatulate, slightly translucent, tawny-whitish, dirty, chalky. Spire conic-turbinate, the apex obtuse, pale buff, glossy; suture deeply impressed. Whorls 6½, convex, regularly increasing, the last one-third the total length. Aperture piriform, narrowed, quite broad in the upper part, and obtusely angular at the base, toothed and lamellate; peristome continuous, expanded, white; right margin having a small tooth-like tubercle which is directed towards the lower end of a strong parietal lamella a little oblique to it; this lamella divides the aperture unequally, and obstructs the entrance; with the tooth of the right margin it forms a sort of second aperture, which is round, a little acute basally. The columella is thickened by a little sinuous fold. The umbilicus is nearly closed by the base of the last whorl, on the outer part of which there are two punctiform pits corresponding to lamellæ of the interior. Length 3, diam. 2¼ mm.

New Caledonia: environs of Noumea and Conception; rare (R. P. Lambert).

Pupa obstructa GASSIES, Fauna Conch. terr. et fluv. de la Nouvelle-Calédonie, ii, 1871, p. 97; Journ. de Conchyl., 1873, p. 52, pl. 2, f. 7.—CROSSE, Journ. de Conchyl., 1894, p. 302. Not *P. obstructa* Al. Braun, 1851.

Distinct by the triangular shape of the aperture, which is obstructed by the parietal lamella, and the unusual expansion

of the peristome. The description is slightly abbreviated from Gassies, and the figure copied from his plate. Both are evidently incomplete. I have not seen specimens. Perhaps related to the Australian *G. hedleyi*, but certainly the description and figure strongly suggest *G. contracta* (Say).

Crosse remarks: A small, quite curious species, dull, chalky, with the aperture exactly in the axis of the shell, subtriangular, contracted towards the base, and obstructed more or less completely by the presence of a strong parietal tooth. Peristome continuous, strongly reflected and white.

VIII. Australian Species.

The Australian Gastrocopts are so closely related to those of eastern Asia that the theory that they were derived from that region appears to have no competitors. Two groups seem to have entered the continent, (1) an ancestral *Sinalbinula* stock, which probably gave rise also to the exclusively Australian section *Australbinula*, and (2) the *macdonnelli* group of *Sinalbinula*. In northeastern Queensland, with the islands of Torres Straits and southern New Guinea, the specific uniformity supports Mr. Hedley's view of a Pliocene connection with Papua.

The inexactness of the existing literature would have stood in the way of any adequate revision of the species had it not been for the generous help of Mr. Charles Hedley of the Australian Museum, both with information on particular species and with many specimens. I have also the advantage of a set of Central Australian Pupæ received from Professor Tate. Several species still require elucidation.

Key to Australian Species of Gastrocopta.

Note.—*G. margaretae*, no. 97, and *G. moretonensis*, no. 98, are not included in the key.

a. Columellar lamella short and wholly horizontal.

b. Shell sinistral, 2.95 to 3.4 mm. long; New South Wales. *G. strangei*, no. 94.

b[1]. Shell dextral, smaller.

c. Length 2.6 to 2.9 mm.; teeth well developed. *G. pediculus*, no. 95.

c^1. Length 2 to 2.4 mm.; teeth rather small and slender; Queensland coast.

G. p. queenslandica, no. 95*a*.

c^2. Length 2 mm.; West Australian coast.

G. mooreana, no. 96.

a^1. Columellar lamella horizontal in front, *curving downward within*.

b. Columellar lamella situated high, curving downward but slightly within; shell narrow, cylindric, the diam. less than half the length; 5 to 5⅓ whorls. Western Australia. *G. tatei*, no. 100.

b^1. Inner end of columellar lamella rather strongly descending; diam. about half the length; scarcely 5 whorls. Northern Queensland to New Guinea.

c. Columellar lamella of moderate size.

G. macdonnelli, no. 99.

c^1. Columellar lamella very large.

G. m. macrodon, no. 99*a*.

a^2. Columellar lamella obliquely and steeply *ascending* inward.

b. Parietal lamella long and very much curved, its crest flaring towards the periphery. New South Wales.

G. hedleyi, no. 101.

b^1. Parietal lamella shorter, its crest not flaring outward.

c. Parietal lamella rather strongly curved towards the columella within, moderately long. Eastern Queensland. *G. mussoni*, no. 102.

c^1. Parietal lamella shorter and less curved. Western Australia.

d. Aperture about one-third the total length of shell.

e. No interpalatal plica.

G. larapinta deserti, no. 103*a*.

e^1. An interpalatal plica present.

G. larapinta, no. 103.

d^1. Aperture one-fourth the total length.

G. wallabyensis, no. 104.

Series of G. pediculus.

Columellar lamella horizontal, submedian.

G. margaretae and *G. moretonensis* are lost species, of which the columellar structure is not known. Until new collections are made in the type localities, one can do no more than copy the original descriptions and figures.

94. GASTROCOPTA STRANGEI (Pfeiffer). Pl. 26, figs. 3 to 6.

The shell is sinistral, rimate, oblong-conic, striatulate, glossy, hyaline; spire convexly turrited, the apex rather acute. Whorls 5, a little convex, the last about ⅔ the length, ribbed in front, the base of a somewhat swollen compressed shape. Aperture subvertical, large, truncate-oval, nearly 7-toothed: two close together on the parietal wall, 2 on the columella, and 3 deep within the outer and basal margins. Peristome white calloused, expanded throughout. Length 3, diam. 1⅓ mm. (*Pfr.*).

Australia: Gordon (= Garden) Island, Port Jackson (Strange, in Cuming and Pfr. coll.). Clyde River, Paramatta, Port Stephen, and many localities in the vicinity of Sydney, as Darling and Glebe Points, Lyndhurst, Chatsworth, South Creek, N. S. W. (Masters, Cox); Balmoral Beach (Ch. Hedley). Narrabri (C. T. Musson).

Pupa strangei PFR., Monographia Heliceorum Viventium, iii, 1853, p. 560; iv, p. 686; Proc. Zool. Soc. Lond., pt. xx, 1852, p. 69 (May 23, 1854); KÜSTER, Conchyl. Cab., p. 179, pl. 21, f. 20, 21.—Cox, Monographia Australian Land Shells, 1868, p. 80, pl. 14, f. 15, 15*a* (bad); exclusive of "dextral variety." —SMITH, Zool. Voy. Erebus & Terror, 1875, p. 3, pl. 4, f. 8 (bad).—*Bifidaria strangei* Pfr., PILSBRY, Proc. A. N. S. Phila., 1900, p. 426, fig. 4.

This common species in New South Wales is readily known by the large size, sinistral coil and simple columellar lamella.

The angular lamella approaches the middle of the parietal, and is united thereto by a callous, the whole having the shape of the letter "y". The union is less complete in specimens seen from Sydney (pl. 26, fig. 3) than in those from Narrabri, an inland locality (pl. 26, figs. 4, 6). The columellar lamella

is short and horizontal (pl. 26, fig. 5). The basal fold is exactly at the junction of columellar and basal borders, almost subcolumellar in position; and sometimes there is a minute denticle (infrapalatal) near it, in the base, but this is present in but few of the specimens examined. The rather short lower palatal plica has the usual form of an entering fold. The upper palatal is shorter, and descends inward, therefore appearing wide or flat-topped in a front view in the Narrabri specimens; in the typical form from Sydney it is small and tubercular. An extremely small or vestigeal suprapalatal may be seen in most individuals. Some individuals might be considered 5-, others 8-toothed, depending upon whether the angulo-parietal be counted as one or two teeth, and whether the infra- and supra-palatal plicæ are sufficiently developed or obsolete.

Length 3.4, diam. above aperture 1.35 mm.; 5⅓ whorls.

Length 2.95, diam. above aperture 1.4 mm.; nearly 5 whorls.

95. GASTROCOPTA PEDICULUS (Shuttleworth). Pl. 26, fig. 1.

See p. 145. Along the coastal slope of New South Wales, from Picton about 200 miles northward, but not over the watershed westward, so far as known, this species occurs in a form scarcely, if at all, different from the typical Polynesian examples, though the largest specimens slightly surpass those of Polynesia. It has been known as *Pupa rossiteri* Brazier.

Specimens collected by Mr. Brazier and labeled by his own hand are before me, received through Mr. Hedley. They are from the Rose Bay side of Point Piper, Port Jackson, taken under decaying leaves at the roots of Lantana by Mr. Brazier in 1865 (pl. 26, fig. 1). Besides being dextral, it differs from the closely allied *G. strangei* in some small details of the teeth. The angular lamella is relatively lower, the parietal more salient. In a basal view these lamellæ are arranged very much as in *strangei*. The columellar lamella is stout, short and horizontal. The basal fold is almost subcolumellar in position. Lower palatal plica is lengthened, the upper tuberculiform.

Length 2.85, diam. 1.3 mm.; fully 5 whorls.

It appears to me likely that this species was imported into

New South Wales, on plants, at an early day, and being well adapted to the local conditions, became commonly diffused.

Mr. Brazier's account follows.

"*Pupa (Vertigo) rossiteri.* — Shell dextral, rather oblong, thin, shining, nearly smooth, white, hyaline; spire turrited, apex obtuse; whorls 5½, roundly convex, the last about quarter the length of the whole shell; aperture squarely oval, armed with five teeth, one on the centre of the body whorl thickened and of a lamellated form, second on the columella on the upper side rather sharp, third small and thin at the lower part of the columella, fourth on the basal margin of the interior of the aperture thick and elongated, fifth on the inner upper side of the outer lip rather obsolete; peristome slightly expanded, thin. Length 1¼, breadth ¾ lines.

"Picton; Rope's Creek; Lake Macquarie; and Wingham, upper Manning River, New South Wales.

"This species is often taken for a variety of *Vertigo strangei* Pfr. The true typical species of *Vertigo strangei* are sinistral, more elongated, and the aperture oval, studded with seven teeth. Dr. Cox, in his Monograph of Australian Land Shells, 1868, figures my species as a variety of *V. strangei*, in plate 14, fig. 18, 18*a*; both species are found in company" (*Brazier*, Proc. Linn. Soc. N. S. Wales, i, 1877, p. 18).

95*a*. G. REDICULUS QUEENSLANDICA n. subsp. Pl. 26, fig. 2.

With a general resemblance to *G. pediculus* (more particularly the Philippine and Hawaiian forms of the species), this race differs by the distinctly smaller teeth, which are both lower and more slender. The basal fold is typically very small, a mere trace; but it varies from moderately small to entirely absent. The parietal callous is very thin, without a raised edge. The shell is thinner and more fragile than in *pediculus*.

Length 2.4, diam. above aperture 1.25 mm. (type, Calliungal).

Length 2.1, diam. above aperture 1.1 mm. (Mapoon).

Queensland: Calliungal (C. T. Musson); Mapoon, at the entrance of Batavia River into the Gulf of Carpenteria (Ch. Hedley).

P. pedicula Shuttlew., Hedley & Musson, Proc. Linn. Soc. N. S. Wales, (2), vi, 1892, p. 558.

Various other localities are given by Hedley and Musson, but they may apply to allied forms of similar appearance. At Calliungal it was associated with *G. mussoni.*

The specimens taken by Mr. Hedley at Mapoon are all smaller than those from Calliungal. This is probably an indigenous Australian race, perhaps identical with *G. mooreana* Smith.

96. Gastrocopta mooreana (Smith). Pl. 30, fig. 4.

Shell short, cylindroid, rimate, brownish-corneous, whorls 5, very convex, slowly increasing, obliquely delicately striate, separated by a deep suture. Spire cylindric, obtuse at the apex. Aperture rounded, provided with 5 unequal teeth (two palatal, one columellar, two parietal), one-third the total length. Peristome lightly expanded and reflected, the margins approaching. Length 2, diam. 1 mm. (*Smith*).

West Australia: Roebuck Bay.

Pupa mooreana E. A. Smith, Proc. Malac. Soc. London, i, 1894, p. 97, pl. 7, f. 25.—? Tate, Rep. Horn Sci. Exped., ii, Zool., 1896, p. 206.

"The largest tooth is that situated on the whorl midway between the ends of the peristome. It juts out into the aperture and points between the two palatal denticles, which are about the same size as that on the columella. The fifth tubercle is at the insertion of the labrum. Named in honour of Capt. W. U. Moore, R. N., in command of the *Penguin*" (*Smith*).

The figure given by Mr. Smith is too small and indistinct to show specific characters. It is copied in my fig. 4. Mr. B. B. Woodward, who has kindly looked at the type specimen, informs me that the columellar lamella enters horizontally. Later I hope to illustrate one of the type lot.

97. Gastrocopta margaretæ (Cox). Pl. 26, figs. 7, 8.

"Shell dextral, yellowish-brown, minutely perforate, oval, under the lens closely and finely striated, opaque; whorls 5, convex, the last equalling ½ the length of the shell; suture

shallow; aperture squarely oval, having 5 teeth (plicæ), 1 large and unequally divided, situated in the centre of the last whorl, with the points separated, a 2nd sharp and pointed, opposite to the first bifid tooth, and a 3rd and a 4th on the columellar side between the 1st and 2nd, the one nearest the columella being thick and blunt, almost a rounded projection, the other is short and sharp; a 5th, situated between the first two, inserted near the junction of the peristome with the body whorl, is short and thick at the base; peristome thickened, dilated and reflected, smooth and white, as also are the teeth, margins joined by a broad thick callus, forming the peristome a continuous circle. Diameter 0.06, length 0.13 of an inch" (*Cox*).

South Australia: Wallaroo (Masters).

Pupa margaretæ Cox, Monograph of Australian Land Shells, 1868, p. 80, pl. 14, f. 20, 20*a*.

Said by Cox to be in the Australian Museum (1868), but no specimens are now known to be extant, and Mr. Hedley puts it among the lost species. So far as I know, nothing additional to Cox's account has been published in fifty years. The description and figures offer no definite differences from *G. pediculus* (*rossiteri*) unless in the size — it is said to be 3.25 mm. long.

98. Gastrocopta moretonensis (Cox). Pl. 26, figs. 12, 13.

"Shell small, dextral, subperforate, ovate, faintly obliquely striated, yellowish horny, apex obtuse; whorls 4½, rounded, the last equalling more than half the length of the shell; suture deep and broad; aperture squarely oval, longer than broad, having four teeth (plicæ), one large and bifid, placed closely together, each pointed, the points divergent, situated in the center of the aperture on the body-whorl; a second, longer and thicker, directly opposite to the bifid one; a third near the columella midway between the other two, short and pointed, thickened at and about its base; a fourth less prominent, and directly opposite to the last, the whole dividing the aperture into four equal parts; peristome thickened, broadly and irregularly expanded, smooth and white, as also are the

teeth; margins joined by a broad, thick callus, continuous with the peristome. Diameter 0.06; length 0.11 of an inch" (*Cox*).

Queensland: Moreton Bay (Masters).

Pupa moretonensis Cox, Monograph of Australian Land Shells, 1868, p. 81, pl. 14, f. 21, 21*a*.

Cox's figures are copied. His description indicates a shell having four (five) teeth in cruciform arrangement: an angulo-parietal, a "longer and thicker" lower palatal, a columellar, which from the description may be presumed to be of the horizontal type, and a small upper palatal. No infraparietal or basal is mentioned. A broad, thick parietal callous makes the peristome continuous. The size assigned, length 2.75, diam. 1.5 mm., is about that of *G. pediculus* (*rossiteri*), which, however, has a basal fold.

Until further collections are made in the type locality, the status of *G. moretonensis* will remain uncertain. None of Cox's specimens are known to be extant, and Mr. Hedley regards it as a lost species. It has been reported as *Vertigo moretonensis* Cox by Tryon, Proc. Roy. Soc. Queensland, v, 1888, p. 136, from Mundoolun, Albert River, collected by A. J. Norton.

Series of B. macdonnelli.

Columellar lamella horizontal in front, its *inner end turning downward.*

99. GASTROCOPTA MACDONNELLI (Brazier). Pl. 27, figs. 9, 11, 12.

"Shell small, dextral, umbilicately fissured, oblong, thin, shining, smooth, white; whorls 5, rounded, the last small, suture impressed, narrow, apex obtuse; aperture somewhat squarely ovate, longer than broad, denticulated with 5 teeth, 4 prominent, the upper one large, placed in the center of the aperture, and extending upwards in a thick rounded callus, the second placed to the left, minute and rounded, the third on the columella, thick and pointed, the fourth facing the upper, moderately pointed, the fifth about equal in size to the fourth; the aperture divided into four parts, peristome thick-

ened and expanded, smooth and white, margins joined by a thick callus continuous with the peristome and extending over the body-whorl. Length 1, breadth ½ lin." (*Brazier*).

N.-E. Australia: Fitzroy Island; also No. 8 Island, Claremont group (Brazier). No. 3, Barnard Islands; Cape York (Brazier, 1877). Also Bet, Sue, Nepean, Dungeness and Warrior Islands, Torres Strait (Brazier, for *P. macleayi*).

Pupa (Vertigo) macdonnelli Braz., Trans. Roy. Soc. N. S. Wales, 1874, p. 30 (not seen); Proc. Zool. Soc. Lond., 1874, p. 669, pl. 83, f. 22, 23; Proc. Linn. Soc. N. S. W., i, 1877, p. 128.—*Vertigo macdonelli* Brazier, Hedley, Proc. Roy. Soc. Queensland, v, 1888, p. 65.

Pupa (Vertigo) macleayi Braz., Proc. Linn. Soc. N. S. Wales, i, 1877, pp. 110, 128. — *Bifidaria macleayi* Brazier, Hedley, Proc. Linn. Soc. N. S. W., xxvii, 1902, p. 19, pl. 3, f. 39 (Barnard Is. No. iii).

Brazier's description is not clear, as he did not recognize the angular tooth as distinct from the parietal, mentioning it as a "thick rounded callous," and he neglected to mention the basal fold. His figure shows angular, parietal and columellar lamellæ, upper and lower palatal and basal plicæ.

No. 8 Island, Claremont group, may be considered type locality. Specimens from there are figured, pl. 27, figs. 11, 12. The angular and parietal lamellæ are well united, forming an anteriorly biramose tooth. Inwardly it bends towards the columella. The infraparietal is well-developed, tubercular, a little lengthened inwardly. The columellar lamella is crescentic, the outer end horizontal, the inner turning downward. The lower palatal plica is about twice as long as the upper, the two standing nearly parallel in some, or converging a little inwardly in other individuals. Basal fold is well developed and short, exactly basal in position.

Length 2.3, diam. 1.15 mm. (subconic form).

Length 2.2, diam. 1.05 mm. (subcylindric typical form).

This species differs from others of eastern and northeastern Australia by having the inner end of the columellar lamella *curved downward;* other similar species of the region having a straight, horizontally entering columellar lamella.

There is some variation in shape in the lot sent by Mr. Hedley, as shown in the figures. The specimens are part of Brazier's original lot.

Pupa macleayi was described by Brazier as sinistral, but Hedley, who examined the collection, writes: "Of *Pupa macleayi* Brazier, there are lots from Bet, Nepean and Warrior Islands, Torres straits, in the Macleay Museum. These are certainly originals, yet all are dextral." Specimens sent, from Bet Island, which I would select as type locality, agree so fully with *G. macdonnelli* that no distinction seems possible. The most obese of three is figured, pl. 27, fig. 9. It measures, length 2.35, diam. above aperture 1.2 mm. It has a small interpalatal plica, but this varies, and is absent in other examples.

It appears certain that Brazier was mistaken in calling *P. macleayi* sinistral, for near the end of his description he describes the lip as of a dextral shell—"the right [margin] slightly angled at the suture, joining the minute tooth above." These terms are wholly applicable to the dextral specimens before me, and would not fit a sinistral shell.

The original description follows.

Pupa (Vertigo) macleayi. — "Shell sinistral, perforated, ovately oblong, very thin, shining, white, hyaline, finely striated, crossed with spiral striæ; whorls 5, convexly rounded, two center large and ventricose, two upper small, the last very small, somewhat compressed; aperture small, squarely oval, longer than broad, having 7 teeth, 3 on the center of the body-whorl, the center one elongated, curved and rounded, small one to the right and left, one long and broad on the inside of the columella, three more situated inside the base, center one deep down opposite the one on the body-whorl; margins continuous, the right slightly angled at the suture, joining the minute tooth above, peristome thin and reflected, broadly expanded over the perforation. Length 1, breadth ½ line (*Brazier*).

Bet, Sue, Nepean, Dungeness and Warrior Islands, Torres Straits (Brazier).

99*a*. G. MACDONNELLI MACRODON n. subsp. Pl. 27, figs. 7, 8, 10.

The shell is ovate-conic, rimate, cartridge-buff, composed of

about 4½ rather strongly convex whorls. Surface little shining, faintly striate and most minutely granulose, as usual. The aperture is rounded-quadrate, with essentially the tooth arrangement of *G. macdonnelli*, from which this form differs by *the very much larger size of the columellar lamella*, the greater part of which is turned downward along the columellar axis, therefore appearing very large in a front view. Typically both infraparietal nodule and basal fold are present (figs. 7, 10), but in some specimens the infraparietal is wanting, and the basal reduced (fig. 8).

Length 2, diam. 1 mm. (fig. 10; type).

Length 2.1, diam. 1 mm. (fig. 9).

New Guinea: Mita, Milne Bay (Charles Hedley).

Pupa pedicula Shuttl., Hedley, Proc. Linn. Soc. N. S. Wales, (2), vi, 1891, p. 99 (exclusive of references).

The form of the columellar lamella separates this species from *G. pediculus*, and allies it to *G. moellendorffiana* and various Asiatic species as far north as Japan.

In one specimen the space between the angular and the forward continuation of the parietal lamella is filled with callous deposit, so that the tooth does not appear forked in front. This variation is occasionally seen also in *G. pediculus*.

100. Gastrocopta tatei n. sp. Pl. 26, figs. 9, 10; pl. 30, fig. 12.

The shell is dextral, cylindric, grayish or bluish white, smooth, rimate. Whorls convex. Angular lamella running from near the insertion of outer lip, converging towards the parietal, with which it is joined by a lower callous. Parietal lamella stronger, slightly curved in a basal view, the concavity towards the columella. Infraparietal lamella is tubercular, slightly lengthened. The columellar lamella is situated *high on the columella*, is stout and *subhorizontal, curving downward a little towards the inner end.* The basal fold is well developed, and situated on the basal part of the columellar margin, being subcolumellar in position. Lower palatal plica is long and enters more deeply than the upper. Upper palatal plica is placed somewhat obliquely, converging in-

wardly towards the lower. Both stand on a thin callous. The peristome is thin and well expanded.

Length 2.8, diam. above aperture 1.07 mm.; 5⅓ whorls.

Length 2.5, diam. above aperture 1.1 mm.; 5 whorls.

Central Australia (Horn Expedition).

This species is readily distinguishable from other known central Australian species by the form of the columellar lamella, which shows affinity with the Torres Strait species *G. macdonnelli*. It is a narrower shell than *G. pediculus*.

The specimens were picked out of lots sent as *Pupa larapinta* and *mooreana* by Professor Tate. It differs from both in the direction of the columellar lamella, among less important characters.

By an error of the artist, the columellar lamella was incorrectly shaded in fig. 10, giving a false idea of its shape. In pl. 30, fig. 12 it is drawn correctly.

Section *Australbinula* Pilsbry.

Columellar lamella obliquely ascending and receding above, the inner end of the parietal lamella curving towards the columella; other teeth as in the other Australian Gastrocopts. Type *G. hedleyi* (*G. rossiteri* Pils., p. 11, not of Brazier).

101. GASTROCOPTA HEDLEYI n. sp. Pl. 27, figs. 1, 2, 3, 4.

This is a dextral, cylindric shell, the upper third tapering to the very obtuse summit, composed of 5 rather strongly convex whorls; of a grayish or bluish white color, imperfectly transparent. The surface is smooth, scarcely showing striation. The parietal lamella is high and thin, long, bent in crescent form, as seen in a basal view (pl. 27, fig. 1); the inner half is highest, and the middle is waved down with the edge flaring towards the periphery. The angular lamella is a quite short and thin lamella, highest in the middle, running from the outer lip, and forming a "V" with the forward end of the parietal, which its low inner end does not quite touch. The infraparietal lamella is short, and more deeply immersed than the parietal (pl. 27, fig. 1). The columellar lamella is a broad plate which ascends obliquely backward, and in profile view

(pl. 27, fig. 4) it is nearly straight. The extremely small basal fold is tubercular. The upper palatal plica is short and oblique, descending inward. Lower palatal plica is a large, weakly sigmoid lamina, at first entering, then curving upwards, then entering again. There is no noticeable palatal callous. The peristome is thin and well expanded.

Length 2.5, diam. above aperture 1.1 mm.

New South Wales: Narrabri (C. T. Musson). Type 63279 A. N. S. P., paratype in Australian Museum.

G. rossiteri PILSBRY, this volume, p. 11. Not *Pupa rossiteri* Brazier, which is also a *Gastrocopta.*

The long, peculiarly-shaped parietal lamella and the very large columellar lamella readily distinguish this species. I have given it a name honored in Australian malacology.

102. GASTROCOPTA MUSSONI n. sp. Pl. 27, figs. 5, 6.

The shell is subcylindric, grayish-buff, slightly shining and faintly striate, of 4½ strongly convex whorls. Aperture with 7 teeth. The angular lamella is rather short and straight, joining the parietal, but with a notch between. The parietal lamella is high and long, its inner end curving towards the columella. Infraparietal lamella small, entering. The columellar lamella is large and ascends obliquely inward. Its lower and outer end is abrupt. The lower palatal plica is long, curved a little upward within. Upper palatal smaller, short. The basal fold is quite small. Lip is thin and well expanded.

Length 2.4, diam. above aperture 1.2 mm. (type; fig. 5).

Length 2.2, diam. above aperture 1.15 mm. (paratype, Australian Mus.).

Queensland: Calliungal (C. T. Musson).

This species is intermediate between *G. hedleyi* and *G. larapinta deserti,* but nearer to the latter. The columellar and parietal lamellæ are larger than in *larapinta;* the parietal enters more deeply and is more curved. The details of tooth structure sufficiently separate *mussoni* from *hedleyi.*

The basal fold is sometimes absent in individuals apparently adult.

The examination of larger series from various Queensland

localities will be required to show whether this is to be treated as a distinct species, or as an eastern race or subspecies of *G. larapinta.*

Form having an interpalatal plica, pl. 30, fig. 8.—A series of shells found with the specimens of *G. pediculus queenslandica* and *mussoni*, at Calliungal, Queensland (C. T. Musson), agrees in most respects with *G. larapinta*, having an interpalatal plica, exactly as in that form. There is usually a small basal fold, sometimes lacking. The shells average smaller, thinner, just perceptibly more obese than *larapinta.* The parietal lamella is shorter and less curved than that of the associated *G. mussoni.*

Length 2.3, diam. above aperture 1.2 mm.

In the lot from Calliungal, sent by Mr. Hedley, I find 9 specimens of this form, 8 *mussoni*, and several *G. pediculus queenslandica*, the latter readily separable by the short, horizontal columellar lamella. Whether the present form belongs to *larapinta* or to *mussoni* I am uncertain.

103. GASTROCOPTA LARAPINTA (Tate). Pl. 30, figs. 5-7, 9-11.

"Shell dextral, oblong-elliptic, pellucid, white, narrowly umbilicated. Spire cylindrical, obtuse at the apex; whorls five, very convex, separated by a deep suture, ornamented by very oblique striæ of growth; last whorl slightly ascending at the front; aperture roundly oblong, multidentate within; peristome narrowly and horizontally expanded, the margins united by a thin parietal callus. The dentition of the aperture consists of two lamelliform, contiguous plaits on the parietal wall, the outer one of which is the larger, an equally large plait on the columella, one on the basal margin, and one on the outer lip. All these are approximately equidistant. In addition, denticles occasionally appear, one exterior to the large plait on the parietal wall, one anterior to the columella plait, and one or two on the outer lip. Length 3, diameter 1.25 mm." (*Tate*).

Central Australia.

Pupa larapinta TATE, Report on the work of the Horn Scientific Expedition to Central Australia, Pt. ii, Zoology, Feb., 1896, p. 205, pl. 19, f. 19 *a, b.*

The broad, obliquely ascending columellar lamella and the slightly arcuate parietal lamella (in basal view) are features in common with *G. hedleyi*, but it differs from that by the far smaller lamellæ.

A very similar form has been found in Queensland. See under *G. mussoni*. Two lots of this species were received from Prof. Tate, evidently, from their appearance, from different localities; also some specimens mixed with the species he called *mooreana*, from a third locality, I think. All were labeled "Central Australia"; so that the exact points where the species was collected must remain unrecorded.

This is a variable species in the number of lamellæ and plicæ developed in addition to the five constant ones, being comparable to the North American *G. pentodon* in this respect. The forms I have seen may be described as follows:

(*a*) Typical *larapinta*, pl. 30, figs. 5, 6, 7. The parietal lamella is strongly developed, and in basal view is seen to be slightly curved. The lower and much shorter angular lamella converges toward it and is rather weakly connected at the inner end. The infraparietal is tubercular, round or shortly oval, and is present in all specimens seen. In some individuals it is weak and not conspicuous in a front view. This was evidently the case with Tate's figured specimen.

The columellar lamella is large, placed obliquely on the axis, receding upwards, the upper end sloping gradually, the lower and outer end much more abruptly terminated. It is shorter than in *G. hedleyi* (see pl. 27, fig. 4), but of the same character.

The basal fold is variable in size, at the junction of columellar and basal margins. The lower palatal plica is rather long and stout. Upper palatal much shorter, subtuberculiform. Between them an interpalatal plica stands, intermediate in size between the upper and lower.

The peristome is thin and well expanded. In some individuals there is a low crest behind the lip, but in others this is scarcely perceptible.

Length 2.55, diam. above aperture 1.2 mm.

Length 2.35, diam. above aperture 1.22 mm. (shortest specimen seen).

(*b*) Professor Tate's description was not drawn from any one specimen, but was composite, like the lots he sent out. His figure showing the aperture, copied in my pl. 30, fig. 10, shows angular, parietal and columellar lamellæ, basal, upper, lower and interpalatal plicæ. This particular form, *lacking the infraparietal lamella*, is represented by two examples in the series sent me, one of them having the basal fold reduced to a minute vestige. It is relatively scarce, about 12 per cent of the shells received; and as the terms of the description include also the far commoner form described in paragraph (*a*), it seems best to regard that as the typical form of the species.

(*c*) Similar to the typical form, but the basal fold is reduced to a small, inconspicuous pad, or not perceptible (pl. 30, fig. 11; length 2.75, diam. 1.2 mm.). Often smaller, length 2.44 mm.

(*d*) Similar to the typical form, but having the basal fold twinned (pl. 30, fig. 9).

In every specimen of *G. larapinta* seen, the interpalatal plica is present, with the upper and lower palatals forming a graded series. The infraparietal tubercle is rarely wanting, but the basal plica is decidedly variable in development.

(*e*) *G. larapinta deserti* n. subsp. Pl. 30, figs. 1, 2, 3. The shell is subcylindric, thin, gray-whitish. Angular and parietal lamellæ as in *larapinta*, but both thinner, the parietal less curved. No infraparietal lamella or tubercle. Columellar lamella and upper and lower palatal plicæ as in *larapinta*. There is no interpalatal plica, and the basal fold is wanting (or in some specimens is present, but small or minute). Peristome is well expanded, thin.

Length 2.25, diam. above aperture 1.15 mm.

Length 2.25, diam. above aperture 1 mm.

Central Australia: Tempe Downs, Reedy Creek, Palm Creek, Stuart's Pass, Painta Spring and Alice Springs (Tate, for *P. mooreana;* Horn Exped.). Northwestern Australia at Forrest River, 18° 33′ S. lat., 125° 8′ E. lon. (Richard Helms).

The specimens sent by Professor Tate, two of which are figured in pl. 30, figs 2, 3, were partly in the same lots with *G. larapinta* and *G. tatei*, and were mostly labeled *P. mooreana* by Professor Tate. This identification I at first accepted, but according to advices from London, the types of *mooreana* have a horizontally entering columellar lamella, while in this form the lamella ascends inwardly. Shells like pl. 30, fig. 11, having an interpalatal plica but no basal fold, were also included in *mooreana* by Tate, who figured one of that form in his pl. 19, fig. 20.

It differs from *larapinta* by the absence of infraparietal and interpalatal plicæ, in the series of 20 seen; the size is a little less; yet bearing in mind the analogous case of *G. pentodon* (Say), I feel doubtful about its subspecific distinction from *G. larapinta.*

In one specimen of the lot the angular lamella is very small, visible only on close inspection.

Specimens from Mr. Hedley, collected by Mr. Helms at Forrest River (pl. 30, fig. 1), are a little larger, 2.5 to 2.55 mm. long, diam. 1.1 mm., or 2.4, 1.2 mm. There is no brownish tint except what may be caused by the dried animal. There is a small infraparietal nodule in some examples, wanting in others. The columellar lamella has a rounded outline and ascends obliquely inward. Lower palatal plica is strong, the upper smaller and far shorter. There is no basal fold. The lip expands broadly. This place is not very far from the type locality of *Pupa mooreana* Smith.

104. Gastrocopta wallabyensis (Smith).

Shell dextral, cylindroid, pellucid, white, narrowly rimate; whorls 5, very convex, separated by a deep suture very obliquely striate, the last ascending in front. Spire cylindrical, obtuse at the apex. Aperture small, ringent, one-fourth the total length, having seven unequal teeth (three small parietal, the middle one largest, one large lamelliform columellar, and three large lamelliform palatals); peristome lightly expanded, the margins approaching, joined by a thin callous. Length 2.5, diam. 1 mm. (*Smith*).

West Australia: East Wallaby Island, Houtmans Abrolhos (Walker).

Pupa wallabyensis E. A. Smith, Proc. Malac. Soc. London, i, 1894, p. 97.

"The teeth of this species are very characteristic, and block up the aperture to a considerable extent. The three parietal are much smaller than the rest, and situated close together, the central one being the largest. That on the columella is large, lamelliform, and prominent. The central palatal tooth is narrow, long, and extends inwards; those on each side of it are shorter, but a trifle more prominent, perhaps.

"*P. macdonnelli* Brazier, from Fitzroy Island, N. E. Australia, is a little shorter than this species and has more feeble armature in the aperture" (*Smith*).

Mr. B. B. Woodward, who has kindly examined the type specimen for me, states that the columellar lamella ascends within. The species is therefore related to the polymorphic *G. larapinta*. It differs by the unusually small aperture (only one-fourth the total length, while in *larapinta* it is at least one-third), and the narrower contour of the shell. It has not been figured.

The Hypselostoma-Boysidia Group.

These forms are similar to *Gastrocopta* in dentition and in the thin shell of not many whorls (4 to 6). They differ from *Gastrocopta* by the markedly conic spire, when the shell is Pupiform. In certain aberrant forms the spire is much depressed, and in all the last whorl becomes horizontal or (usually) ascends. Its tendency is to become tangential. The peristome is generally continuous. They inhabit a large part of the Oriental Region.

Gredler and von Möllendorff have discussed the connection of *Hypselostoma* and *Boysidia* through several species of intermediate form. The latter authority, however, would not unite both in one genus, holding that the free and produced last whorl of *Hypselostoma* sufficiently differentiates it from *Boysidia*.

It may be assumed that the primitive forms of the *Hypse-*

lostoma and *Boysidia* group, like *Odontocyclas, Fauxulus,* and some other members of the same subfamily, had independent angular and parietal lamellæ. In one series this primitive condition has persisted; in another these lamellæ have united. The primary division of the group should therefore be into two series:

(1) *Forms which have retained the angular and parietal separate and parallel,* and (2) *those in which these two lamellæ have become more or less completely concrescent,* as they have in *Gastrocopta.*

A secondary division of both of these series may then be based upon the character of the last whorl, whether adnate to the preceding, as in normal Pupæ (a primitive condition), or becoming free, extended or upturned (a highly evolved condition).

This gives us the following arrangement:

	Parietal and angular separate	Parietal and angular concrescent
Last whorl free	*Gyliauchen*	*Hypselostoma*
Last whorl adnate	*Paraboysidia*	*Boysidia*

If my interpretation of the facts of structure is sound, it appears that the free last whorl in *Hypselostoma* and *Gyliauchen* is a secondary character assumed independently in terminal members of two phyletic series. These two genera are not directly related, but are allied through genera of normal form.

The two groups *Bensonella* and *Anauchen* are side lines, differentiated in tooth structure.

The most primitive Boysidia, *B. strophostoma,* has retained an early structure in the separate angular and parietal lamellæ, and in this single character (but not in form of the columellar lamella), it approaches *Paraboysidia.* In the latter group, the species *robusta* and *kelantanensis* have evolved parallel to the *Boysidiæ* in the single character of united angular and parietal lamellæ, retaining the columellar structure

proper to their group. It is this interlacing of characters which has influenced me to retain *Boysidia* and *Paraboysidia* in one genus. Eventually I believe that the two will be separated; but no doubt a great many species remain to be discovered in southern China and Indo-China, and they will test the distinctions now drawn.

The diagnostic characters of the genera and subgenera are given below in the form of a key, in which entries are also made for the determination of aberrant species.

Key to Genera and Subgenera.

a. Angular and parietal lamellæ concrescent into one sinuous or lobed lamella.
  b. Last whorl adnate to the preceding.
    c. Columellar lamella descending steeply inward. BOYSIDIA.
    *c*¹. Entering part of columellar lamella horizontal; peristome interrupted above, *Boysidia robusta*.
  *b*¹. Last whorl becoming free, projecting or ascending. HYPSELOSTOMA.
*a*¹. Angular and parietal lamellæ distinct and parallel.
  b. Last whorl adnate to the preceding.
    c. Columellar lamella horizontally entering.
      d. Teeth ending outwardly in hooks. BENSONELLA.
      *d*¹. Teeth simple, not hooked. PARABOYSIDIA.
    *c*¹. Columellar lamella descending inward, *Boysidia strophostoma*.
  *b*¹. Last whorl becoming free and projecting. GYLIAUCHEN.
*a*². No angular lamella, the parietal standing alone; last whorl adnate to the preceding. . . . . ANAUCHEN.
*a*³. No teeth in the aperture; last whorl becoming free in front, *Hypselostoma edentulum*.

Genus HYPSELOSTOMA Benson.

Tanystoma Bens., Ann. and Mag. N. H. (2), xvii, p. 130, Feb. 1856; not of Latreille, 1829 (Diptera).—*Hypselostoma* Bens., t. c., April, 1856, p. 342; monotype *T. tubiferum*.—*Tonkinia* J. Mabille, Bull. Soc. Malac. France, iv, 1887, p. 123; monotype *T. mirabilis*.

The shell is umbilicate, spire conoidal, elevated or depressed, spirally striate; the last whorl angular or carinate, *becoming free*, the free portion more or less ascending, straight or twisted upward; aperture varying from subvertical to horizontal and looking upward, usually toothed, *the angular and parietal lamellæ wholly concrescent into one irregular lamella;* peristome expanded. Animal externally as in *Gastrocopta*, having long eye-stalks and short tentacles.

Type *H. tubiferum* (Bens).

Distribution: Burma, Tonkin, etc., the Loochoo Islands and Philippines.

According to Blanford and von Möllendorff the Hypselostomas are rock snails, living on limestone, generally covered with lime dust. They nestle in cracks and holes, and often are hard to see.

Hypselostoma differs from *Gyliauchen* by having the angular and parietal lamellæ concrescent into a single bilobed lamella. It is a more evolved genus than *Gyliauchen*, which retains the primitive structure of two parallel lamellæ. The lamellæ and plicæ of *Hypselostoma* are never spiniferous. The genus was apparently derived from Boysidioid ancestors, and differs from *Boysidia* chiefly by the free last whorl; also by the spiral striation, which, however, is almost obsolete or relegated to an early neanic stage in some species.

The chief teeth are usually placed in form of a cross, the parietal and lower palatal, the columellar and upper palatal being symmetrically opposed. The basal fold is very often wanting, but the upper palatal plica is, with few exceptions, larger and more constant than in *Gastrocopta*.

In *H. tubiferum, H. mirabile* and *H. roebeleni* the last whorl is twisted upward, bringing the plane of the aperture nearly parallel to the equatorial plane, and elevated above the de-

pressed spire. The animal therefore carries the shell inverted. In other species the aperture approaches more to the vertical position, though it always looks upward somewhat.

The genus *Tonkinia* of Mabille has not been described or illustrated well enough to permit one to form a definite opinion, but for the present it may be placed in the synonymy of *Hypselostoma*. It was defined as follows:

Shell discoidal with convex spire; last whorl strongly carinate, inverted at the end, carrying a toothed aperture, provided with a sinus or oval gutter at the summit and towards the suture; umbilicus wide, permitting the whorls to be seen (*Mabille*).

The few continental species known belong to several groups. *H. annamiticum* appears to be somewhat related to Philippine species. I do not know where *H. laidlawi* belongs, and the same is true of *H. dayanum*, which has been placed in *Paraboysidia*.

The single Loochooan species is closely related to those of the Philippines.

The Philippine group consists of species having spiral striation (sometimes present only on early whorls), a thin peristome, and there is usually no basal plica. It may be regarded as a natural group, of common ancestry; but the modifications have been considerable, two extremes being represented by *H. edentulum*, in which the aperture is slightly oblique and toothless, and *H. rochebleni*, having the shell depressed and the aperture turned up, as in *H. tubiferum*. I have not seen *H. polyodon* or *H. pusillum*. It is likely that many more species will be found, as those known are scattered from Luzon to Bohol, many intervening islands having none recorded.

H. laidlawi, no. 4, and *H. dayanum* (*Boysidia? dayana*) are not included in the following

Key to Species of Hypselostoma.

a. Diameter about double the altitude, openly umbilicate, with low-conoid or depressed spire, the aperture turned upward, nearly horizontal.

b. Alt. 2, diam. 5 mm.; white. Tonkin.
H. mirabile, no. 2.

*b*¹. Diam. 4 to 4.5 mm.

c. 5 to 7 teeth, the upper palatal bilobed; spiral striation very faint or obsolete on last whorl. Burma, etc. *H. tubiferum*, no. 1.

*c*¹. 4 teeth, the upper palatal simple; spirally striate. Philippines. *H. roebeleni*, no. 11.

*a*¹. Spire conic or pyramidal; umbilicus narrow except in the last half-whorl; aperture subvertical or moderately inclined upward.

b. Aperture without teeth; diam. 3.25 mm., equal to or exceeding the alt. Calamianes, Philippines.
H. edentulum, no. 12.

*b*¹. Aperture having teeth.

c. Alt. 3.8 to 4.4 mm., exceeding the diam.; last whorl scarcely ascending, shortly free, densely striate spirally and not conspicuously angular. Annam. *H. annamiticum*, no. 3.

*c*¹. Smaller, more delicate insular species.

d. Alt. 1.75, diam. 2.3 mm.; 6 teeth. Loochoo Is. *H. insularum*, no. 5.

*d*¹. Philippine species.

e. 6 teeth, the parietal very strong; alt. 2, diam. 2.66 mm. Tablas.
H. polyodon, no. 8.

*e*¹. 4 or 5 teeth, there being no basal plica.

f. Neck long, but little ascending; last whorl strongly carinate and spirally striate. Luzon. *H. luzonicum*, no. 6.

*f*¹. Neck rather short, the last whorl angular, not spirally striate; alt. 2.5, diam. 2.2 to 2.5 mm. Bohol.
H. quadrasi, no. 9.

f^2. Neck rather short, ascending; 2 x 2 mm. Coron, Calamianes. *H. pusillum*, no. 10.

f^3. Neck very shortly free and strongly ascending; alt. 2, diam. 2.3 mm. Sibuyan. *H. sibuyanicum*, no. 7.

Continental Species.

1. HYPSELOSTOMA TUBIFERUM (Benson). Pl. 31, figs. 1 to 5.

Shell depressed conoid, very lightly radially striate, corneous; spire shortly conoid, the apex rather obtuse; suture channeled; whorls 3½, convex, the last forming a tube which is drawn out and twisted upward, above the summit; at the periphery strongly, obtusely carinate; having on the upper surface a swollen belt separated from the periphery by a deep furrow, the lower surface convex, angular to the aperture around the open, perspective umbilicus. Aperture nearly horizontal, looking upward, 6 or 7 toothed, teeth lamelliform, two parietal (the superior stronger, doubled, the inferior small and deeply placed), one moderate columellar, four palatals, of which the upper one is duplicate and the third one larger. Peristome expanded throughout, a little reflected. Greatest diam. 4, min. 3, height 2 mm. (*Pfr.*).

Burma: Thyet-Mio, on the banks of the Irawadi, on limestone rocks (Blanford, Theobald, Oldham). Ava (Benson): Peak of Mya Leit Doung, about 20 miles south of Mandalay; Tsagyen Hills; and in Pegu as far south as Henzada (Blanford).

Tanystoma tubiferum BENS., Ann. Mag. N. H. (2), xvii, 1856, p. 130. — *Hypselostoma tubiferum* Bens., PFR., Novit. Conch., i, p. 130, pl. 36, f. 1-4; Monogr. Hel. Viv., iv, 325; v, 437.—STOLICZKA, Journ. Asiatic Soc. Bengal, xl, 1871, p. 173, pl. 7, f. 1.—BLANFORD, J. A. S. B., xxxii, 1863, p. 326.—HANLEY & THEOBALD, Conch. Indica, pl. 8, f. 3.—GUDE, Fauna of Brit. India, Moll., ii, 1914, p. 298.

In this type species of *Hypselostoma* the angular and parietal lamellæ are wholly concrescent into a single lamella with

strongly bilobed crest. The upper palatal plica is also bilobed, and with the angulo-parietal forms an oval sinulus. The other lamellæ and plicæ are deeply placed. Lower palatal and columellar large, basal fold smaller. A very deeply immersed, short infraparietal lamella is often developed, and usually a short interpalatal plica; so that there may be as many as 7 or as few as 5 teeth. In *H. roebeleni* the angulo-parietal lamella is less distinctly bilobed, the upper palatal plica is short and simple, and interpalatal, basal and infraparietal teeth are absent. *H. mirabile* also seems to have fewer teeth. The usual diameter of *H. tubiferum* is 4.3 to 4.4 mm. The length of the neck varies.

When cleaned with sufficient care (and not too much), delicate spiral striæ may be seen in places on the second and third whorls, but they are easily removed. The embryonic shell comprises 1½ whorls, and is minutely granulose.

"In some places hundreds may be found adhering in dry weather to the surface of limestone rock, upon which alone it appears to occur, in the same manner as species of *Pupa* and *Clausilia* are frequently found in Europe. The animal of *H. tubiferum* is very small and black, of the usual helicidous form, with 4 tentacles" (*Blanford*).

"The specimens I saw were pale gray; they had the eye pedicels rather more elongated than usually in species of *Pupa*, and more resembling those of *Helix;* the tentacles at the base of the rostrum were very minute, both blackish. The rostrum itself is thick and very minutely notched at the front edge. The foot is short, ovately elongated, roundly truncate posteriorly. The animal, when moving, carries its shell in a reverse position" (*Stoliczka*).

2. HYPSELOSTOMA MIRABILE (J. Mabille). Pl. 31, figs. 6, 7.

Shell very small, broadly umbilicate, subdepressed-convexly-discoidal, rather solid, scarcely shining, white, roughly striatulate under a strong lens. Spire convex; apex large, mamillate, corneous, glossy. Whorls 4, convex, gradually and regularly increasing, separated by a simple, impressed suture, the last whorl large, nearly equal in width to the penultimate

as viewed from above, at the periphery carinate, ascending towards the aperture, inflated next to the suture above, then subconvexly sloping, below impressed at the carina; convex, and radially rib-striate around the umbilicus. Aperture entire, turned upward, irregularly oblong, toothed—one strong, entering parietal lamina, another smaller columellar, surrounding a little channel. Peristome thickened, continuous, free, the outer margin spreading. Diam. maj. 5, min. 4, alt. 2 mm. (*Mabille*).

Tonkin.

Tonkinia mirabilis MABILLE ("Moll. Tonk. Diag., p. 9; May 14, 1887"); Bull. Soc. Malac. de France, iv, 1887, p. 123, pl. 1, f. 4, 5.

The figures, which I copy, are incorrect, according to Mabille. "The apertural lamellæ and the gutter have not been represented; the aperture is not elevated enough, and the carina is not shown." The gutter mentioned is, I suppose, the sinulus, commonly more or less conspicuous in *Hypselostoma.*

3. HYPSELOSTOMA ANNAMITICUM Moellendorff.

Shell perforate, irregularly trochiform, rather thin, delicately striatulate, decussated by microscopic spiral lines, rufous-brown. Spire elevated conic, the apex somewhat obtuse, glossy. Whorls 5½, subangularly convex, separated by a deeply impressed suture, the last whorl ascending in front, shortly free and built forward, indistinctly angular in front of the suture, below the periphery and in the middle of the base. Aperture nearly vertical, rounded-trapezoidal; peristome continuous, moderately expanded, spreading. Parietal lamella bifid, strong, deeply entering; columellar lamella strongly elevated, deep; 3 palatal teeth, two larger plicæ forming a cross with their opposites, the third basal, small. Diam. 3.5, alt. 3.8 mm. (*Mlldff.*).

Annam: Phuc-son (Fruhstorfer).

Hypselostoma annamiticum v. MLLDFF., Nachrbl. Deutschen Malac. Ges., vol. 32, Oct. 1900, p. 133.

H. transitans of Samui is understood to be the nearest rela-

tive; like this species, the new one stands perhaps on the border between *Boysidia* and *Hypselostoma*, which are further linked together by forms like *B. boettgeri* of Java and *strophostoma* from the West River above Canton. The last whorl becoming free, and its angulation, though quite weakened, influence the reference to *Hypselostoma* (*Mlldff.*).

3*a*. *H. a. altius* n. subsp. Pl. 31, figs. 11, 12, 13.

The specimens before me differ somewhat from von Möllendorff's diagnosis, and probably constitute a race or subspecies. The base is barely perforate, much more narrowly than in *Boysidia hunana.*

The shell is larger and especially higher and narrower than *H. annamiticum.* Chestnut-brown, very densely sculptured with filiform, minutely crinkled and often interrupted spiral striæ. Whorls 5½, convex, not angular, the last straightened and built forward, very indistinctly subangular above and at the periphery, rounded beneath. Angulo-parietal lamella bilobed. The columellar lamella is bent downward, but enters horizontally. The upper palatal plica descends somewhat. Lower palatal has the broad summit deflected upward. The lip is strongly thickened within.

Alt. 4.25, greatest diameter including lip 3.7 mm.

Alt. 4.35, greatest diameter including lip 3.75 mm.

Annam (Fruhstorfer).

Except in color, this shell has little in common with *H. transitans,* the concrescent angular and parietal lamellæ and the sculpture being notably diverse in the two species.

4. Hypselostoma laidlawi Collinge. Pl. 31, figs. 14, 15.

Shell dextral, conical, with last whorl dorsally grooved, surface smooth, deeply umbilicated; whorls 5, regularly increasing; aperture CO-shaped, armature consists of four teeth, a dorsal and a ventral one situated on the upper and lower border of the peristome, and two smaller internal teeth, one on the right and one on the left of the peristomial teeth; peristome thin, slightly reflected. Alt. and diam. i millim. (*Collinge*).

Malay Peninsula: Biserat Caves, State of Jalor (Skeat Exped.).

Hypselostoma laidlawi COLLINGE, Journ. of Malacol., ix, Sept. 29, 1902, p. 83, pl. 5, f. 29, 30.

From the insufficient description and figure, the affinities of this species cannot be determined. It is of about the size of *H. dayanum*, but has fewer teeth — parietal, columellar, upper and lower palatal, according to the description. Nothing is said of an angular lamella, which should be present if it is related to the *bensoniana* group. Mr. Collinge's figures are copied. I suspect that the artist slanted the sutures in the wrong direction. The shell may be a *Gyliauchen*.

Loochoo Species.

5. HYPSELOSTOMA INSULARUM Pilsbry. Pl. 32, figs. 1 to 4, 6.

The shell is very small, conic, with wide, nearly flat base; thin, pale brown, dull and lusterless, faintly striate, and encircled with minute spiral striæ. Whorls 4½, convex. The penultimate whorl becomes flat in its last half. The last whorl has a strong but not acute peripheral keel, which does not reach to the aperture. Above the keel the whorl is flattened and concave; below it is slightly convex. Near the aperture the whorl is straightened, loses the keel and becomes convex above and below, somewhat tubular. It ascends slowly. The base is weakly convex with a minute central perforation and a long, curved, umbilical suture. The aperture stands free of the preceding whorl, and looks upward somewhat. It is irregularly rounded. The peristome is continuous, free, thin and expanded throughout. There are six teeth situated deep in the throat, as follows: A high, compressed, deeply entering angulo-parietal lamella, the angular portion of which flares towards the periphery where it overrides the parietal portion; a thin entering columellar lamella which curves downward and descends slightly as it enters; a minute subcolumellar lamella; a rather large upper palatal plica, and a smaller, more deeply placed and basally situated lower palatal, with a minute interpalatal plica between these two.

Alt. 1.75, diam. 2.3 mm.

Loochoo Is.: Yonakunijima (Y. Hirase). Type 95,252 A. N. S. P.

Hypselostoma insularum Pils., The Conchological Magazine, ii, 1808, p. 41, fig. 2.

This species resembles *H. luzonicum* Mlldff., from near Manila, in shape. It differs by the much smaller size, shorter neck, the presence of a subcolumellar (or it may possibly be a basal) fold, and the more sinuous angulo-parietal tooth of the Loochoo species. The very fine and delicate spiral striæ seem to be of cuticular substance.

Philippine Species.

6. Hypselostoma luzonicum Moellendorff. Pl. 32, figs, 7, 8, 9.

Shell narrowly perforate, thin, corneous-brown. Whorls 5½, angulate-convex, separated by a deeply impressed suture, striatulate, the upper ones angular below the middle, forming a turrited-conic spire, the last whorl flattened, having a slight spiral sulcus over the basal carina, free almost from the middle, built out a long way, somewhat ascending. Crested at suture and periphery, around the umbilicus and on the back, so that it is somewhat tetragonal, at the base distinctly lineolate spirally. Aperture turned upward very little, rounded-quadrangular, with 4 or rarely 5 teeth opposed cross-like; parietal lamella strong, high, entering deeply, somewhat flexuous; columellar smaller, horizontal, receding; two or three teeth in the throat. Peristome simple, thin, a little expanding. Alt. 2⅛, width 2½, alt. and width of aperture 1 mm. (*Mlldff.*).

Philippines: Antipolo, province of Manila, Luzon, on limestone.

Hypselostoma luzonicum Mlldff., Nachrbl. d. Mal. Ges., 1888, p. 145; Bericht Senckenberg. Ges., 1890, p. 250, pl. 9, f. 1; with var. *major*, p. 250, pl. 9, f. 2, and var. *imbricata*, p. 250, pl. 9, f. 3.

The angular lamella is wholly concrescent with the parietal, but its inner end, where it joins the parietal, is very slightly deflected towards the periphery. The upper palatal converges inward towards the lower, and a smaller interpalatal stands

between them in most specimens from the type locality which I have seen, but it is sometimes absent. There is no basal fold. A sinulus is indistinctly defined by a prominence or boss on the inner margin of the lip. The peristome is very thin throughout. The original figures, copied in figs. 7, 8, are somewhat diagrammatic, in Dr. Boettger's usual manner.

6*a*. *H. l. major* Mlldff. Pl. 32, fig. 10.

Differs from the type by the larger, more solid shell, more convex, less angular whorls, the last one not or but slightly sulcate spirally; peristome more expanded, somewhat labiate, and having a minute accessory denticle between the parietal and columellar lamellæ. Alt. 2½, width 3, aperture alt. and width 1⅛ mm. (*Mlldff.*).

High mountains of Morong district, Luzon.

6*b*. *H. l. imbricata* Mlldff. Pl. 32, figs. 11, 13.

Differs by the slightly smaller, more slender shell, the whorls being more distinctly angulate-carinate, the last having the spiral sulcus more deeply excavated, aperture smaller, peristome less expanded; generally 3 small, acute palatal teeth. Alt. 1⅞, width 2⅛, alt. and width of aperture ⅞ mm. (*Mlldff.*).

Near the town of Medellin, northern Cebu. Fig. 13 is from a specimen from the Quadras collection.

H. l. lubanicum Mlldff. is mentioned in the *Verzeichniss*, in Abhandl. Naturforsch. Ges. Görlitz, vol. 22, 1898, p. 126, from Luban. I have not found a description.

7. HYPSELOSTOMA SIBUYANICUM Moellendorff.

Shell rimate, thin, irregularly turrited-conic, very delicately striate, opaque, pale corneous-brown. Spire turrited-conic, with somewhat glossy, oblique apex. Whorls 5, convex, separated by a strongly impressed suture, the last whorl rather flat, obtusely carinate below the middle, slightly guttered above the carina, strongly ascending in front, very shortly free and built forward. Aperture inclined backward, rounded-rhomboid; peristome simple, thin, much expanded. Parietal lamella strong, much elevated, three rather long, sub-

equal teeth, opposed in form of a cross. Diam. 2.3, alt. 2 mm. (*Mlldff.*).

Philippines: a high mountain of Sibuyan (C. Roebelen).

Hypselostoma sibuyanicum MLLDFF., Nachrbl. d. Mal. Ges., vol. 28, Feb. 1896, p. 11.

8. HYPSELOSTOMA POLYODON Moellendorff.

Shell narrowly perforate, turbinate, thin, pellucid, delicately striatulate, opaque, buff-corneous. Spire rather elevated, the sides concave, apex oblique, obtuse. Whorls 5, convex, separated by a deeply impressed, almost channeled suture, the last whorl obtusely carinate at the periphery, impressed above the carina, subsulcate, base flat; in front it is shortly free and built forward, moderately ascending, the carina suddenly disappearing at the beginning of the ascent. Aperture strongly inclined backward, rounded-rhomboid. Peristome thin, narrowly expanded throughout. Parietal lamella very strong, nearly ⅔ the height of the aperture, flexuous; on the right margin a rather long lamella approaching the former; columellar short but rather strong; three rather strong basal teeth. Diam. 2.66, alt. 2 mm. (*Mlldff.*).

Philippines: Tablas; taken by a native collector.

Hypselostoma polyodon MLLDFF., Nachrichtsbl. d. Mal. Ges., vol. 28, Feb. 1896, p. 12.

9. HYPSELOSTOMA QUADRASI Moellendorff. Pl. 32, fig. 5.

Shell most narrowly perforate, irregularly pyramidal, thin, somewhat pellucid, minutely striatulate, opaque, brown. Spire elevated conic, the apex obtuse. Whorls 5, angularly convex, separated by a rather deep suture, the last shortly free and built forward, a little ascending. Aperture vertical, rounded-tetragonal. Peristome shortly expanded, thin. Parietal lamella and columellar moderate, two teeth in the throat opposite them in form of a cross. Diam. 2.5, alt. 2.5 mm. (*Mlldff.*).

Philippines: Sierra Bullones, Bohol.

Hypselostoma quadrasi MLLDFF., Nachrbl. d. Malak. Ges., vol. 28, Aug. 1896, p. 88.

The last whorl has a rounded angle in front, but in the last half this is pinched up into a rounded keel with a concavity above it. The glossy apical whorl is set rather sparsely with minute granules, and faint traces of spiral threads may usually be seen on the following whorl or two, the last whorl being smooth, matt, with some wrinkles along growth-lines in the umbilicus. The upper palatal plica descends a little inwardly.

Alt. 2.4, diam. 2.3 mm.

Alt. 2.5, diam. 2.2 mm.

Related to *luzonicum*, but not so thin, smooth, the neck very short. Figured from topotypes from the Quadras collection.

10. HYPSELOSTOMA PUSILLUM Moellendorff.

Shell rimate, turbinate, thin, finely striatulate, corneous, the spire much elevated, gradate. Whorls 5½, angularly convex, separated by a very deeply impressed suture, the last whorl obtusely carinated at the periphery, planulate at base, distorted and ascending, its last fourth free, built forward, almost quadrangular behind the aperture. Aperture somewhat slanting backward; peristome simple, thin, shortly expanded. Parietal lamella rather elevated, another smaller one in the outer margin opposite and nearly touching the former, and with it inclosing a circular sinulus; columellar and palatal low and very deeply placed. Diam. 2, alt. 2 mm. (*Mlldff.*).

Philippines: Coron Island, Calamianes (C. Roebelen).

Hypselostoma pusillum MLLDFF., Nachrbl. d. Mal. Ges., vol. 26, June 1894, p. 100.

11. HYPSELOSTOMA ROEBELENI Moellendorff. Pl. 31, figs. 8, 9, 10.

Shell moderately and perspectively umbilicate, depressed-conoid very lightly radially striatulate, somewhat decussated by spiral microscopic lines, corneous-brown. Spire gradate, moderately elevated, the sides a little concave, apex somewhat obtuse. Whorls 4½, convex, separated by a deep suture, the last bent upward from the middle, then becoming free, and

built upward in a tube of good size, upper side and at the periphery obtusely carinate, deeply guttered above the carina, obtusely angular around the umbilicus. Aperture almost horizontal, looking upward, rounded-tetragonal; peristome simple, thin, expanded throughout. Parietal lamella strong, much elevated, somewhat doubled; one columellar and two palatal lamelliform teeth opposed in form of a cross. Diam. maj. 4, min. 3, alt. 2.1 mm. (*Mlldff.*).

Philippines: Coron, in the Calamianes group (C. Roebelen). Also Busuanga.

Hypselostoma roebeleni Mlldff., Nachrblatt. d. Malak. Ges., vol. 26, June 1894, p. 100.

This species differs from *H. tubiferum* by the sculpture, absence of a basal keel around the far narrower umbilicus, the want of a basal lamella, and other features. It is not directly related to *tubiferum*, being a species of the Philippine group which, evolving parallel to *tubiferum*, has reached the same stage. It has the sculpture, texture and dentition of other Philippine species.

12. Hypselostoma edentulum Moellendorff. Pl. 32, fig. 12.

Shell perforate, elevated turbinate, thin, subpellucid, lightly striatulate, somewhat decussated by microscopic spiral lines, corneous-brown. Spire rather elevated, the sides straight, apex oblique, rather obtuse. Whorls 5¼, angularly convex, separated by a very deep suture, the last whorl obtusely angular at the periphery, ascending gradually, then becoming shortly free. Aperture vertical, rhombic, the peristome free, thin, narrowly expanded throughout. No teeth. Diam. maj. 3.25, alt. 3.25 mm. (*Mlldff.*).

Philippines: Sangat Island, Calamianes group (C. Roebelen).

Hypselostoma edentulum Mlldff., Nachrbl. d. M. Ges., vol. 26, June 1894, p. 100.

Well distinguished by the absence of teeth. The initial whorl has minute granules, which on its latter part become arranged in spiral rows, spiral striæ appearing on the second whorl.

The texture, sculpture and form show that this species belongs to the *luzonicum* group, or at least that it was derived from some form of that group; but it has diverged remarkably in a single character, the loss of all teeth. Two specimens measure:

Alt. 2.6, greatest diameter 3.25 mm.

Alt. 2.75, greatest diameter 3.2 mm.

Genus ANAUCHEN, n. gen.

The shell is umbilicate, pyramidal, light-colored and spirally striate, last whorl scarcely or not ascending and *not free*. The aperture is rounded, oblique, the peristome broadly expanded but thin, shortly adnate above. *No angular lamella;* parietal and columellar lamellæ developed, the latter horizontal; 0–3 plicæ in the lip.

Type *H. gereti* (B. & D.).

This group is peculiar for having lost the angular lamella, leaving a simple parietal. Except in *H. messageri*, the other teeth are more or less completely degenerate. I do not know whether *A. rochebruni* and *angulina* are spirally striate or not. All but the last are from Tonkin.

This group is related to *Hypselostoma* by the spiral sculpture but differs by having no angular lamella, and the last whorl is adnate. This last is not a very important difference, and one which may perhaps disappear with future discoveries. I do not think it closely related to *Boysidia*.

Key to Species.

a. Last whorl swollen but not angular.

b. Five well-developed teeth; alt. 3, diam. 2.5 mm. or smaller. *A. messageri*, no. 1.

b[1]. Three small teeth, parietal, columellar and lower palatal; alt. 3.5, diam. 2.7 mm. *A. gereti*, no. 2.

a[1]. Last whorl somewhat angular at periphery and umbilicus.

b. Two teeth, parietal and lower palatal; alt. 4, diam. 3 mm. *A. rochebruni*, no. 3.

b[1]. A parietal tooth only; alt. 3½, diam. 2⅔ mm. *A. angulinus*, no. 4.

1. ANAUCHEN MESSAGERI (Bavay et Dautzenberg). Pl. 33, figs. 4, 7.

The shell is thin, opaque, deeply umbilicated. Spire pyramidal, turrited, obtuse at the summit, composed of 5 convex whorls, separated by a very deep suture, and ornamented with many microscopic, decurrent and noticeably waved striæ. Last whorl feebly ascending at the end. Aperture oblique, rounded, armed with 5 folds. Peristome continuous, broadly expanding. Parietal lamella very strong, compressed laterally, a little sinuous and less emerging than the others. Columellar lamella strong. Three palatal plicæ, the middle one stronger than the others. Color corneous fawn; peristome whitish. Alt. 2⅔, diam. 2 mm.

Haut-Tonkin (Messager); Bac-Kan.

Boysidia messageri BAV. & DAUTZ., Journ. de Conchyl., 1903, p. 211, pl. 9, f. 1-4.

"By its general form and the microscopic sculpture this species resembles *Boysidia gereti*, but it differs by the more rounded aperture, and by the folds within it; they are stronger, project more, and there are three instead of a single one within the outer lip."

Fig. 4 represents a specimen from Bac-Kan measuring, alt. 3, diam. 2.5 mm. The parietal lamella is somewhat arcuate, being bent towards the columella within, but there is no trace of an angular lamella. The plicæ and lamellæ are rather long.

2. ANAUCHEN GERETI (Bavay et Dautzenberg). Pl. 33, figs. 1, 2, 3.

The shell is thin, subpellucid, deeply umbilicate. Spire pyramidal, turrited, obtuse at the summit, composed of 5 to 6 convex whorls, separated by a very deep suture, and ornamented with many waved microscopic spiral striæ. Last whorl not ascending. Aperture obliquely rounded, a little transverse, having three folds. Peristome continuous, broadly dilated and spreading, not reflected at the edge. Columellar lamella immersed, of moderate size. Parietal lamella compressed laterally, stronger and projecting more than the columellar, but not reaching to the edge of the peri-

stome. Palatal plica feeble, short and immersed. Color, a light corneous tint, the peristome and apertural folds whitish. Alt. 3½, greatest diameter 2.7, least 2.3 mm.; aperture 1⅓ mm. high, 1.6 wide (*B. & D.*).

Haut-Tonkin (Messager). Lao-Kay.

Boysidia gereti Bav. et Dautz., Journ. de Conchyl., 1903, p. 212, pl. 9, f. 5-8.

This species is characterized by the concavely pyramidal form, oblique aperture with three small, simple teeth, and the pale color.

The embryonic whorl is glossy, weakly granulose, and shows some very delicate spiral lines. Subsequent whorls are minutely granulose, and the last 2½ spirally striate. The last whorl is swollen above the middle. The parietal lamella is simple and straight; apparently the angular has wholly disappeared. The columellar lamella and lower palatal plica are often very weak. Some specimens from Lao-Kay are less elevated than the type.

3. Anauchen rochebruni (J. Mabille).

Shell umbilicate, subregularly conic-pyramidal, small, uniform corneous, pellucid, fragile, slightly striate under a strong lens. Spire pyramidal, high; apex glossy, large, obtuse. Whorls 5½ to 6, convex, the first gradually and regularly increasing, the rest very rapidly, separated by a deep suture; the last whorl large, convex, angular at the periphery, upper angle disappearing before reaching the peristome, convex below, obtusely keeled around the narrow, perspective umbilicus, near the aperture a little dilated and not descending. Aperture slightly oblique, narrowed by two teeth, one parietal, rather deeply placed, the other palatal, tuberculiform. Peristome interrupted, acute, a little thickened, spreading, white and glossy on the inner side; margins approximating, joined by a very thin callous. Major diam. 3, minor 2, alt. 4 mm. (*Mabille*).

Tonkin.

Hypselostoma rochebruni Mabille ("Moll. Tonk. Diag., p. 8; May 14, 1887"); Bull. Soc. Malac. de France, iv, July 1887, p. 121.

"This species is quite nearly related to the following (*Hypselostoma crossei*), in company with which it appears to live. It differs by the more slender, narrower spire, the less developed last whorl, the more superior angulation of which disappears entirely towards the aperture; finally by the positions and number of the teeth" (*Mabille*).

It has not been figured, but from the description seems related to *gereti*. I suspect that there is a deeply placed columellar lamella.

4. ANAUCHEN ANGULINUS (Gredler). Pl. 33, figs. 5, 6.

Shell thin, perviously and widely umbilicate, trochiform, spire conoidal; apex obtuse; very weakly striatulate, silky, pale corneous; whorls 6, convex, the last rapidly increasing, hardly ascending, obtusely angular at the periphery and umbilicus; aperture diagonal, ample, rounded-tetragonal, toothless except for a simple, low and short parietal fold; peristome very thin, broadly expanded, slightly reflected, the margins joined by a callous which is adnate in the middle and arcuately extended towards the left. Alt. 3⅓, basal width 2⅔ mm. (*Gredler*).

China: Hunan or Hupé.

Pupa angulina GREDLER, Zur Conchylien-Fauna von China, viii, Stück, Bozen, 1885, p. 7; Annalen K. K. Naturhist. Hofmuseums, ii, 1887, p. 285, pl. 11, f. 22, 23.

This species appears to have some resemblance to *A. gereti*, but the teeth are reduced to a single parietal lamella. I have not seen it.

Genus BOYSIDIA Ancey.

The shell is conic, narrowly umbilicate or perforate, opening out broadly in the last half-whorl, which is straightened and built forward to the ventral face; composed of 5 to 6½ convex whorls; the surface minutely granular. Aperture subvertical, essentially hexodont, but additional teeth may be present, or the basal fold may be wanting; angular and parietal lamellæ independent or concrescent into a sinuous lamella. Peristome expanded, either continuous or interrupted and adnate above.

Type: *B. dorsata* (Anc.).

Distribution: from the Yangtze Valley to Java.

For the present, two groups which will possibly be considered of generic value are included in this genus: (1) BOYSIDIA proper, and (2) BENSONELLA with the subgenus *Paraboysidia.*

Key to Species of Boysidia, Bensonella and Paraboysidia.

a. Columellar lamella obliquely descending inward.

b. Angular and parietal lamellæ united into one lobed or sinuous lamella.

c. Alt. 3.3 to 4, diam. about 2.5 mm.

B. hunana, no. 1; *B. dorsata*, no. 2.

*c*¹. Alt. 2.75, diam. 2 mm.; angulo-parietal lamella widest in the middle.

B. hangchowensis, no. 3.

*b*¹. Angular and parietal lamellæ separate, parallel.

B. strophostoma, no. 4.

*a*¹. Entering portion of the columellar lamella horizontal, not descending inwardly.

b. Lamellæ and plicæ terminating outwardly in hooks; angular and parietal lamellæ separate and parallel.

B. plicidens, no. 5.

*b*¹. Ends of the lamellæ and plicæ not hooked.

c. Peristome thick, white, not continuous across the parietal wall.

d. Angular and parietal lamellæ concrescent into one lamella with a spur on the right side; length 5 mm.

B. robusta, no. 6.

d^1. Angular and parietal separate and parallel; length 3 mm. *B. lamothei*, no. 7.

c^1. Peristome continuous across the parietal wall.

d. Small, length less than 2.5 mm.; angular and parietal lamellæ long and parallel.

e. Aperture rounded-triangular with 7 teeth; surface most minutely granular in spiral lines; alt. 1.8, diam. 1.4 mm. *B. paviei*, no. 8.

e^1. Aperture similar, with 9 teeth; granulation uniform; shell narrower; alt. 2.2, diam. 1.5 mm. *B. landurensis*, no. 9.

e^2. Aperture subcircular, 8 teeth; alt. 1, diam. 1.1 mm. *B. dayana*, no. 10.

d^1. Larger, length 3 to over 5 mm.

e. Angular lamella low, converging to the parietal within; space between upper and lower palatal plicæ concave; about 6 teeth; alt. 3.2, diam. 2.5 mm. *B. kelantanensis*, no. 13.

e^1. Angular and parietal lamellæ parallel.

f. 4 to 5 mm. long, with 5 whitish teeth. *B. salwiniana*, no. 12.

f^1. 3 mm. long.

g. An impression behind the outer lip, as in Vertigo antivertigo. S. W. Hupe. *B. hupeana*, no. 11.

g^1. No impression; about 9 teeth. Java. *B. boettgeri*, no. 14.

Subgenus BOYSIDIA s. str.

Boysidia ANCEY, Le Naturaliste, i, March, 1881, p. 373, for *P. dorsata* and *P. plicidens*.—GUDE, Fauna of British India, Moll., ii, 1914, p. 293, type *P. dorsata*.—*Gredleriella* MLLDFF., Jahrb. D. M. Ges., 1884, p. 179, for *P. hunanensis* only.

The angular and parietal lamellæ are concrescent, forming one bilobed lamella (except in *B. strophostoma*, where they are only weakly connected); the *inner end of the columellar lamella turns down.*

Two Chinese species, *B. gracilis* Mlldff. and *B. euconus* Mlldff., are mentioned by Dr. von Möllendorff in his Binnen-Mollusken aus Westchina und Centralasien, ii, 1902, p. 85. I have not seen descriptions.

1. BOYSIDIA HUNANA (Gredler). Pl. 33, figs. 8, 9.

Shell openly umbilicate, turrite-conic, irregularly and weakly striatulate, silky, reddish brown. Whorls 6 to 6½, a little convex, the last produced in a tube in front, somewhat ascending. Aperture ample, oblong, 5-plicate: three short, immersed plicæ in the palate, the lower one punctiform; one lamelliform, obliquely descending around the columella, and one high but thin, flexuous parietal lamella. Peristome expanded, fragile. Alt. 1⅔, breadth 1¼ lines [about 3⅓ x 2½ mm.] (*Gredler*).

China: Yün-tcheu-fu, Prov. Hunan (K. Fuchs, type loc.); throughout the Yangtse valley, common on limestone rocks (Heude).

Pupa hunana GREDLER, Jahrb. d. Deutschen Malak. Ges., viii, 1881, p. 23, pl. 1, f. 5.—HEUDE, Notes sur les mollusques terrestres de la vallée du Fleuve Bleu, p. 76, pl. 18, f. 25.—*Pupa (Gredleriella) hunanensis* Gredl., MLLDFF., Jahrb. D. M. Ges., xi, 1884, p. 179.—*Pupa (Boysidia) hunanensis* var. *conspicua* MLLDFF., Jahrb., xii, 1885, p. 396.

Typical *hunana* has the last whorl built forward, "trompetenförmig erweitert, lostretend und ein wenig ansteigend," according to Gredler's description and figure. So far as I know, this form is local; at least it is not what is commonly known as *hunana* in collections.

The common Yangtse valley form, as well as that from the Marble Rocks, near Canton, is more broadly conic with the peristome barely free from the preceding whorl, and is what von Möllendorff has described as *conspicua*. He says: "The manner of life is that of *Pupa avenacea* and *mühlfeldti*, which are also like it in color. They sit chiefly gregarious on naked limestone rocks, leaving them only in very dry times, and are often frosted over gray with lime dust, so that they are easily overlooked."

1*a*. *B. hunana conspicua* Moellendorff. Pl. 33, figs. 10, 12, 13, 14.

Differs from the type by the distinctly more conic, more solid shell, the umbilicus more open, whorls 5½ to 6 (not 6 to 6½), more rapidly increasing, the last higher and more ventricose; aperture larger for the height of the shell, but with quite similar lamellæ and teeth, peristome more thickly labiate (*Mlldff.*).

China: Tsat-sing-yen or Marble Rocks of the West River above Canton, prov. Guang-dung. Also Tong-king (*Mlldff.*).

The specimen figured measures, alt. 4, diam. including peristome 2.5 mm., with slightly over 6 whorls. Color chestnut-brown, the lip orange-cinnamon. The angular lamella reaches the lip, and is concrescent with the parietal at its inner end, the junction marked by a notch. Parietal is rather short, high, and its inner end curves slightly towards the periphery (figs. 10, 14). The columellar lamella descends obliquely as it enters (fig. 10). The upper palatal plica slopes downward a little as it enters. The peristome is distinctly thickened within.

2. Boysidia dorsata (Ancey).

Shell conic, obscurely corneous-fulvous, rather thin, the apex obtuse. Spire conoidal, 6½ rather convex whorls, the last inflated, rotund, somewhat narrowed before the aperture. Suture impressed. Aperture rounded-oval, thrust forward; peristome reflected, the margins continuous; furnished with two rather deeply-placed teeth in the right margin; two other

lamelliform, somewhat twisted teeth, one above, the other columellar. Apex of the aperture a little directed towards the right. Growth striæ little impressed. Umbilicus patulous, deep. Length 4, width 2.5 mm. (*Ancey*).

China: Lake Poyang (M. Kermorgant).

Pupa dorsata Ancey, Le Naturaliste, i, 1881, p. 373, 407; Il Naturalista Siciliano, ii, 1883, p. 266. — *Boysidia dorsalis* Ancey, Mlldff., Ann. Mus. Zool. Acad. Imp. Sci. St.-Pétersb., vi, 1902, p. 85.

Upon comparing with a specimen of *hunana* from Gredler, M. Ancey considered *dorsata* to be "a variety of *Pupa hunana*, of lighter color, thinner, smaller, with the spire more rounded and less strongly conoidal, the umbilicus narrower, the last whorl less swollen, and the lower tooth of the interior of the right margin very obsolete. Perhaps the species collected by M. von Möllendorff southwest of Canton, and which M. Gredler (Malak. Bl., 1882, 178) declared related to *hunana* but different, is to be referred to the form I described."

3. Boysidia hangchowensis (Pilsbry et Hirase). Pl. 33, fig. 17.

The shell is high-conic, with obtuse apex and convex base, minutely perforate, with a long curved umbilical rimation, dark brown. The spire is straightly conic, composed of 5½ convex whorls. The last whorl ascends slowly to the aperture, its latter part being straightened and built forward to the level of the ventral face of the shell. There is no crest or marked constriction behind the lip. The aperture is truncate-oval, the upper margin straight. Peristome thin, well expanded, continuous; with a shallow dent outside at the upper third of the outer lip. The angular and parietal lamellæ are concrescent into one stout, straight lamella reaching to the margin, wider in the middle of its

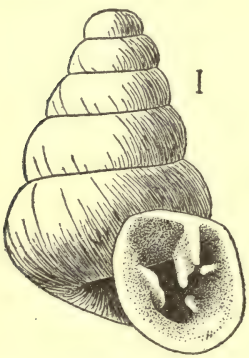


Fig. 17.—*B. hangchowensis.*

length, where it shows traces of its dual composition. The columellar lamella is strong, slopes obliquely downward as it enters, and the outer end reaches to, but not upon, the expansion of the lip. There are two short palatal plicæ, the upper one almost touching the parietal lamella, the lower one slightly more deeply placed. Basal fold extremely minute.

Alt. 2.75, diam. 2 mm.; longest axis of aperture 1.3 mm.

China: Hangchow, province Che-kiang (Hirase). Type no. 94,743 A. N. S. P.

Hypselostoma (Boysidia) hangchowensis Pils., Proc. A. N. S. Phila., 1908, p. 42, fig. 6.

The shell is much smaller than *B. hunana conspicua* Mlldff., with the angular and parietal lamellæ more closely united, the upper palatal approaching nearer to it, and the basal so minute that it is very difficult to see, and probably will prove to be inconstant.

4. Boysidia strophostoma (Möllendorff). Pl. 33, figs. 15, 16.

Shell rather openly umbilicate, turrited conic, very minutely striatulate, corneous-brown. Whorls 6, very convex, the last produced forward, somewhat ascending. Aperture vertical, rounded-tetragonal, the peristome thin, expanded. 3 to 4 palatal plicæ, of which the middle one is longer; columellar strong, spirally receding; parietals 2, the first short, moderately elevated, flexuous, the other deeply placed and approximate to it. Length 2¾, diam. 2¼ mm. (*Mlldff.*).

China: on the marble rocks of Tsat-sing-yen, on the Western River, prov. Guang-dung, taken by a Chinese collector.

Pupa (Boysidia) strophostoma Mlldff., Jahrb. D. M. Ges., xii, 1885, p. 395, pl. 11, f. 23.

The oblique striation resembles that of *B. hunana conspicua;* there is a very fine, indistinct granulation over it. The angular lamella is short, parallel to the parietal lamella, with which its inner end weakly connects by a quite low callous. The parietal lamella is higher and straight. The columellar lamella descends obliquely inward. Upper and lower palatal plicæ are strong, subequal. There is a weak basal and a well-developed suprapalatal plica. Alt. 3, diam. 2.1 mm.

This species differs from *B. hunana conspicua* by its smaller size, thin lip, more separated angular and parietal lamellæ, the presence of a suprapalatal plica, etc. It is less evolved than *hunana* by the less united angular and parietal lamellæ.

Subgenus BENSONELLA Pilsbry.

Bensonella PILS., Proc. A. N. S. Phila., 1900, p. 591, footnote; type *Pupa plicidens.*

The shell is perforate and rimate, conic, minutely granulose, having long, parallel angular and parietal lamellæ, and the usual horizontal columellar lamella and palatal plicæ, all *conspicuously hooked* at their outer ends. Peristome thickened.

This group is closely related to *Paraboysidia*, from which it differs conspicuously by having the teeth hooked. It may be regarded as a specialized *Paraboysidia.* In the sole species known there are many accessory lamellæ and plicæ.

Bensonella has several characters elsewhere seen only in the European genus *Abida.* Such are the interruption of the angular lamella (*cf.* the "spiral lamella" of *Abida*), and the development of lamellæ between the angular lamella and the suture (as in *Abida polyodon*). As *Bensonella* and *Abida* do not seem at all nearly related in other respects, these similar structures are apparently homoplastic. The potentiality, rather than the structure itself appears to have been inherited. It may be noted also that some authors have recognized a certain likeness to *Odontocyclas.*

5. BOYSIDIA PLICIDENS (Benson). Pl. 34, figs. 1-4, 9, 10.

Shell umbilicate, ovate-conic, subtrochiform, rather glossy, obscurely striate, corneous. Five convex whorls, the last ventricose, ascending in front, tumid at the base. Suture impressed. Apex obtuse. Aperture irregular, subtriangular, having 9 folds. Peristome continuous, sinuous, expanded, the margins joined by an expanded callous; right margin impressed in the middle outside, thickened and tubercular within. Three parietal lamellæ, of which the upper two are long; one dentiform columellar; five palatals, two subbasal being minute. Basal margin having a callous outside. Umbilicus narrow. Length 2, diam. 1½ mm. (*Benson*).

India: Landour, type loc., figs. 1, 2, 4, and Mussoorie (Benson); Cherra Poonjee, Assam (Godwin-Austen).

China: Hangchow, prov. Chekiang (Hirase), fig. 3.

Japan: Suimura, Awa (Shikoku); Riozen, Omi; Yoro, Mino, figs. 9, 10.

Pupa plicidens Bens., Ann. and Mag. N. H. (2), iv, 1849, p. 126. — Pfr., Monogr., iii, 553. — Kuester, Syst. Conchyl. Cab., *Pupa*, p. 136, pl. 17, f. 23, 24.—*Boysidia plicidens* Bens., Gude, Fauna of Brit. India, Moll., ii, p. 294.—?? *Hydrocena milium* Bens., Godwin-Austen, P. Z. S., 1872, p. 515, pl. 30, f. 3.

This species is easily known by the numerous lamellæ and plicæ, most of them *terminating outwardly in acute hooks.* The interruption of the angular lamella is also a special feature. Although common, the species has not been accurately described or figured hitherto.

The shell is narrowly perforate, becoming openly rimate in the last half-whorl. It is most minutely, densely granulose, with very few widely-spaced growth-lines, and of a light brown tint. The lip expands very little, but there is a depression behind it preceded by a low crest. Except in the sinulus, the peristome has a callous rim within, and there is a rounded tooth at the upper third of the outer lip, sometimes doubled.

The parietal wall (pl. 34, fig. 10) has more lamellæ than any other species of the genus. The angular lamella is twice as long as the parietal. Deep within, it forms a hook, then becomes reduced to a mere thread, and then enlarges again, to form a stout lamella which emerges to the lip-edge. There are two small, immersed lamellæ, both hooked in front, between the angular and the outer suture, shown in fig. 10. The parietal lamella is short and thick, terminating forward in a hook. Infraparietal is much smaller, also hooked.

The columellar lamella is short, horizontal and hooked, as are the small supra- and sub-columellar lamellæ. These are shown in profile at the left side of fig. 10, as well as in the face views.

The upper and lower palatal plicæ are readily distinguishable by their larger size. There are two small basal plicæ (or

only a single one), an interpalatal, and one to three supra-palatals, which do not show in the figures. All of these plicæ are hooked, except when very small.

Some variation may be noted in specimens from Landour, the type locality. The summit is more obtuse in some examples (fig. 1), smaller in others (figs. 2, 4), these having a fraction of a whorl more, fully 5 whorls. The Japanese specimens have 5 to 5¼ whorls. The smallest specimen measured is a trifle under 2.1 mm. long. Two topotypes received from Benson measure:

Length 2.4, greatest diam. 1.75 mm.; 4¾ whorls (fig. 1).

Length 2.45, greatest diam. 1.9 mm.; 5 whorls (figs. 2, 4).

The number of minor plicæ varies somewhat in different individuals. I have seen specimens with as many as 16 lamellæ and plicæ.

"The animal has four tentacula, the superior pair bearing the percipient points or eyes, the inferior very short. The foot is hyaline, the tentacula and neck fuscous. The shell is carried horizontally. It is very local, although tolerably abundant where found. It creeps among moss, on damp rocks, generally in places which are seldom or never visited by the sun, in some of the lofty and precipitous glens of the mountains near Landour. It seems to be a capricious species. On a rock on which I found it abundantly one year, I could not obtain a specimen at the same season in the following year" (*Benson*).

Col. Godwin-Austen (1872) thought that *Hydrocena milium* Bens. might be the young of this species, but could not reach a positive conclusion. He states that the specimens of *plicidens* from Mussoorie are of smaller size. He alludes also to an undescribed *Pupa* like *plicidens* from the Jhelum Valley, Kashmir, collected by Theobald (Proc. Malac. Soc. Lond., iii, 262).

The writer has been criticized for forming a section (*Bensonella*) for this species. If the shell were larger, so that its peculiar characters could be seen readily, it would hardly have been associated in one section with the true Boysidias. No naturalist who has treated of *B. plicidens* seems to have

seen the hooks of the teeth, and part of the teeth which appear to be constant have not been noticed at all. My conclusions are based upon considerable series from India, China and Japan, including topotypes from Benson.

Though long known from India, *B. plicidens* was first turned up in China and Japan by Mr. Hirase's collectors. It may be wanting in a large part of central and southern China; I cannot otherwise understand how it escaped such observant naturalists as Père Heude, Dr. von Möllendorff, Mr. Schmacker, and others. At present its range appears to be strikingly discontinuous.

Subgenus Paraboysidia Pilsbry.

Paraboysidia Pils., this vol., p. 174, July 18, 1917.

The shell has the shape and minutely granulose surface of Boysidia, but differs by having the angular and parietal lamellæ separate, long and parallel (except in *B. robusta* and *B. kelantanensis*, where they are connected or concrescent). *The columellar lamella enters horizontally* (the inner end not turned downward as it is in *Boysidia*); plicæ situated as usual. Peristome is either continuous or interrupted above, expanded and thickened, a nodule on the inner margin limiting the sinulus.

Type *B. paviei* B. & D.

Distribution: India to Tonkin, south to Java.

This group is closely related to *Bensonella* and to *Gyliauchen*, and indeed it may be regarded as the parent stock from which these groups were derived. Some of the species have the teeth minutely spiniferous, as in *Gyliauchen*.

B. robusta is an accelerated form in which the angular and parietal lamellæ have become concrescent. I do not think it directly related to the Chinese Boysidias, but rather a convergent form belonging to a collateral phyletic line.

6. Boysidia robusta Bavay et Dautzenberg. Pl. 35, figs. 1, 2.

Shell large for the genus, rather solid and turbinate. Spire conoid. Whorls 6, rather convex, joined by an impressed suture, the first whorls smooth, the rest ornamented with

irregular growth striæ. Last whorl laterally compressed, and strongly ascending in front. Aperture vertical, subquadrate, the margins moderately expanded, converging and joined by an adnate callous. Columella very oblique. Lip parallel to the columella; basal margin arcuate. Two parietal lamellæ, the upper one marginal, lamelliform, deeply entering and giving off a triangular, dextrally incurved denticle; the inferior lamella weak and deeply immersed. Columellar lamella submarginal, deeply entering and twisted. Three palatal plicæ, the upper strong, marginal, and then forming in the throat a plate almost reaching the parietal fold; middle one rather strong; lower weak, and both deeply immersed. Color pale tawny, peristome and teeth white. Alt. 5, greatest diameter 3¼ mm.; aperture 2⅓ mm. high, 2 mm. wide (*B. & D.*).

Indo-China: Phong-Tho (Messager).

Boysidia robusta B. et D., Journ. de Conchyl., 1912, p. 18, pl. 3, f. 1-3.

The largest of its group. The angular lamella is high, arcuate, its inner end curving towards the upper palatal plica, and united by a lower callous to the long, deeply entering parietal lamella. The infraparietal is also long, entering deeply. The columellar lamella is long, straight, and descends inwardly. The upper palatal plica arises just inward from the boss on the lip defining the sinulus, and descends inwardly.

7. Boysidia lamothei Bav. et Dautz. Pl. 35, figs. 3-6.

The shell is thin but opaque, turbinate, narrowly perforate. Spire pyramidal, the apex rather obtuse. Whorls 5, convex, gradate, joined by a conspicuous suture, nearly smooth, even under a lens showing only inconspicuous growth-striæ on the later whorls. Last whorl rounded, ascending at the end. Aperture vertical, subquadrate, having many folds, the peristome thickened and dilated, the margins joined by a very thin, glossy and moderately expanded callous. Three parietal lamellæ, the upper lamella marginal, very strong and, with the upper palatal plica, forming a rounded sinulus; middle lamella immersed and lamelliform; lower lamella weak and deeply immersed. Columellar lamella strong. Palatal plicæ

5, the upper marginal and strong, the rest weak, immersed, visible from the outside by their opacity. Color pale tawny, the peristome white. Alt. 3, greatest diam. 2 mm.; aperture 1⅓ mm. high and wide (*B. & D.*).

French Indo-China: Ban-Lao; Muong-Hum and Muong-Kong (Messager).

Boysidia lamothei Bavay et Dautzenberg, Journ. de Conchyl., 1912, p. 21, pl. 3, f. 7-9.

"This species is especially remarkable for its globular shape and the complication of the folds of the aperture."

The palatal plicæ vary in number and size. Sometimes (fig. 3) there are only the two usual plicæ, but in others (fig. 5) there are in addition two in the basal position and an interpalatal, or five in all; the lower palatal plica being scarcely larger than those on each side of it. There may also be some minute folds below the columellar lamella. In fig. 5 the upper palatal plica is nearly concealed behind the nodule of the lip-callous. In an obliquely basal view (fig. 4) the very strong and long angular lamella is seen to stand entirely free of the parietal. The infraparietal is very deeply immersed. Under a strong lens the smaller plicæ and columellar lamella are seen to be minutely spiniferous. The surface is most minutely granulous. The specimens figured are from Ban-Lao, the type locality.

8. Boysidia paviei Bav. et Dautz. Pl. 35, figs. 7, 8.

Shell small, thin but opaque, turbinate, rather widely umbilicate. Spire pyramidal, the apex rather obtuse. Five convex whorls joined by a conspicuous suture, ornamented by very fine, scarcely visible growth-lines. Last whorl not ascending in front. Aperture subtriangular, rather oblique. Peristome continuous, a little dilated. Two strong parietal lamellæ, nearly equal, but the superior is a trifle stronger and marginal, the inferior being a little immersed. Columellar lamella strong, subhorizontal. Four palatal plicæ, the upper marginal, the rest immersed, and all visible through the outer wall. Color brown, the peristome and teeth paler. Alt. 1¾, greatest diam. 1⅓ mm.; aperture ¾ mm. high, ⅘ wide. (*B. & D.*)

French Indo-China: Pac-Kha; Long-Ping (Messager).

Boysidia paviei Bavay et Dautzenberg, Journ. de Conchyl., 1912, p. 20, pl. 3, f. 4-6.

Distinguished by its small size and very long teeth. The angular and parietal lamellæ run parallel, the former being longest (fig. 8). There is no infraparietal. The columellar lamella is strong and enters horizontally. An entering basal plica is subcolumellar in position. Upper and lower palatal plicæ are very long, subparallel, and enter deeply, the lower being stouter. A long slender suprapalatal is seen deeply placed in the sinulus, which is defined by a strong, conic tooth within the otherwise rather thin lip. The large apical whorl shows delicate spirals. Later whorls are most minutely granulose, the granules indistinctly arranged in spiral lines. Two specimens from Pac-Kha, the type locality, measure:

Alt. 1.8, diam. 1.4 mm.

Alt. 1.85, diam. 1.5 mm.

9. Boysidia landurensis (Pilsbry). Pl. 35, fig. 9.

Shell rimate, the rimation like a reversed comma, conical, brownish corneous, nearly lusterless and smooth except for some extremely faint growth-striæ; the apex obtuse, whorls 5, convex, the latter part of the last whorl straightened, slowly ascending. Aperture broadly heart-shaped, vertical, obstructed by three lamellæ upon the parietal wall, two on the columella, and four acute folds or plicæ within the outer and basal margins. Angular lamella not quite marginal, simple, continuous and deeply entering; parietal lamella higher and thicker, not emerging quite so far, and also very deeply entering, its inner end deflected towards the columella; infraparietal lamella quite small and short, more immersed. Columellar lamella deeply immersed, horizontally entering, smaller than the parietal. Subcolumellar lamella minute, tubercular, deep within. Plicæ all remote from the margin, the lower palatal largest, the basal, upper palatal and suprapalatal somewhat smaller, all lamellar. Peristome very narrowly expanded, continuous, having a perceptibly thickened rim within the basal and outer margins which terminates in a white

tubercle above the middle of the outer lip. Above this tubercle the lip is thin and strongly arcuate. Length 2.2, diam. 1.5 mm.

India: Landour, with *B. plicidens* Bens. Type no. 16721 A. N. S. P.

Bifidaria (Bensonella) landurensis PILSBRY, Nautilus, vol. 29, Nov. 1915, p. 73.

This species is related to *B. paviei*. It is more lengthened than that species, with more numerous and more regularly increasing whorls, of a paler color. The surface does not show the minutely granulose spirals of *paviei*. *B. landurensis* is perceptibly smaller than *B. plicidens*, and differs from that species in the following respects: the angular lamella does not emerge quite to the edge of the peristome, and *it is continuous*, not interrupted, within. The parietal lamella is less remote from the lip-edge, emerging nearly as far as the angular. The lower palatal plica is somewhat stronger, there are fewer plicæ, and finally, none of the teeth terminate anteriorly in hooks.

10. BOYSIDIA (?) DAYANA (Stoliczka). Pl. 34, figs. 5, 6.

Shell minute, conoidal, rather solid, pale brown, with the apex rather obtuse, widely and deeply, perspectively umbilicate; whorls 4, convex, separated by a deep suture, the first smooth, somewhat mamillate, the rest marked with subobsolete growth-striæ; the last whorl largest, coiled nearly in a plane, subangular above at the periphery, then gradually narrowing and obtusely angular at the verge of the umbilicus. Aperture nearly vertical, slightly descending, dilated, subcircular; margins joined, a little thickened within, and having fold-like teeth. Labium adnate, moderately expanded, two-toothed, the upper tooth larger. Labium 6-toothed: two rather separated teeth on the columellar region, two others in the outer lip, similar and distinct from one another, but the two in the basal margin are small and near together. Diam. maj. 1.1, min. 0.8, alt. 1 mm. (*Stol.*).

Burma: Damotha, near Moulmain.

Hypselostoma dayanum STOL., Journ. As. Soc. Bengal, xl, 1871, p. 172, pl. 7, f. 2.—Hanley & Theobald, Conch. Indica, 1876, pl. 147, f. 10.—GUDE, Fauna Brit. Ind., Moll., ii, p. 300.

A single specimen of this very interesting species was found together with *Georissa liratula, Diplommatina crispata* and *carneola*, etc., on the limestone hill at Damotha. It is the third known species of the genus. In general form it resembles Blanford's *H. bensonianum* from near Ava, but differs in the shape of the last whorl and in the dentition of the aperture. The latter is in both species almost vertical, not turned entirely upwards, as in the type of the genus, *H. tubiferum*. As regards form, the present species indicates still more distinctly the affinities of *Hypselostoma* to *Pupa* than does *H. bensonianum* (*Stol.*).

So far as I can learn, only the original specimen has been found. It is placed here on account of the adnate upper margin of the peristome, but it may perhaps belong to *Gyliauchen*.

11. Boysidia hupeana (Gredler).

Scarcely differing in size from the smaller form of *Hypselostoma hunanum*, but less turrited, more conic. Also the two folds of the parietal wall are not placed one behind the other, and, except for a depression or saddle, concrescent into one, as in *hunanum*, but standing wholly free alongside one another, as in *strophostoma* Mlldff. From this, however, the folds referred to are diverse, in that the larger apertural fold emerges to the margin, and is higher and sharper. The chief differential character of this species lies in the callous impression of the outer lip, running along the outside (à la *Vertigo antivertigo* of Europe), corresponding to a sharp, elevated palatal lamella running deep within, reaching up near to the fold on the parietal wall. Alt. 3, breadth 2 mm. (*Gredler*).

China: southwestern Hupé.

Hypselostoma hupeanum Gredler, Nachrichtsblatt d. deutschen Malak. Ges., vol. 33, Oct. 1901, p. 151.

In the absence of details of structure of the columellar lamella, etc., the position of this species remains uncertain.

12. Boysidia salwiniana (Theobald). Pl. 33, fig. 11.

Shell pyramidal, rimate, brown-corneous, covered with a smooth epidermis; whorls 6, a little convex, joined by an impressed suture, the last shortly ascending at the aperture.

Aperture rounded-oblong, a little dilated, and more than one-third the total length, having 5 whitish teeth: the first parietal tooth large, lamellar, median, another smaller parietal placed at the suture; third tooth small, at the umbilicus; fourth and fifth in the lip, submedian and at base, moderate, equidistant. Lip simple, not reflected. Length .16, width .09, alt. of aperture .06 inch [= alt. 4, diam. 2.25 mm.] (*Theob.*).

"This species resembles *P. bathyodon* Bs., but is more acuminately and regularly pyramidal" (*Theob.*).

Burma: Shan States (Fedden); Bhamo (Anderson); Pingoung, Shan Hills (Godwin-Austen).

Pupa salwiniana Theob., Journ. Asiatic Soc. Bengal, vol. 39, 1870, p. 400.—Hanley & Theobald, Conch. Indica, 1874, pl. 100, f. 9.—Sowerby, Conch. Icon., xx, 1876, pl. 16, f. 150.—Pfr., Monogr., viii, 403.—Nevill, J. A. S. B., vol. 46, 1877, p. 23; Zool. Res. Two Exp. W. Yunnan, i, 1879, p. 882.—*Pupa salwineana* Theob., Godwin-Austen, P. Z. S., 1888, p. 244.—*Boysidia salwiniana* Theobald, Gude, Fauna Brit. India, Moll., ii, p. 295.

Probably related to *hupeana*. I have not seen the species, and copy the figure from *Conchologia Indica*. Mr. Gude has given the following notes: "Theobald states that the species resembles *P. bathyodon* Benson, but is more acuminately and regularly pyramidal. I have not seen *bathyodon*, but to judge by the figures in Conch. Ind. the comparison is not a happy one. *B. salwiniana* appears to me to assimilate rather with *plicidens*. The spire, however, is more attenuated, and the shell is about twice as large. There is also an inflection of the right (outer) margin of the peristome, which is continued as a horizontal superficial groove on the outer wall, corresponding with an elongated horizontal fold on the inside of the right margin, a feature which still further tends to connect this species with *plicidens*, and induces me to place it in the genus *Boysidia*.

"Two specimens in the Beddome collection (British Museum), labeled Burma, are rather larger than the type, measuring 5.2 x 3.5 mm. including the peristome. Godwin-Austen, who records it from Pingoung, Shan Hills, at an altitude of

2500 feet, mentions that the only perfect specimen found was bleached, but a smaller imperfect one was covered with a brown epidermis. He calls it a very beautiful little shell, which undoubtedly it is'' (*Gude*).

13. BOYSIDIA KELANTANENSIS Sykes. Pl. 35, figs. 10, 11, 12.

The shell is conic, perforate, chestnut-brown, most minutely granulate, and having some widely-spaced lines of growth, composed of nearly 5 strongly convex whorls, the last half of the last whorl straightened, horizontal, angular at the periphery, flattened below the angle, the rest of the base convex; the umbilicus has a spiral furrow within, and there is a depression behind the outer lip, just above the periphery. The aperture is very slightly oblique, squarish with rounded angles. The angular lamella is very low, converging within to and joining the parietal. Parietal lamella short, rather strong. A tubercular infraparietal near the columella. Columellar lamella short, horizontal. Upper and lower palatal plicæ strong, a concavity of the wall between them. Basal plica small and short. All of the teeth are densely set with microscopic pointed granules. Peristome thin, well expanded, continuous, and barely free from the preceding whorl above. Alt. 3.2, diam. 2.5 mm.

Malay Peninsula: Kelantan (Waterstradt).

Boysidia kelantanense SYKES, Journ. of Malac., ix, 1902, p. 61, pl. 3, f. 7.—*Boysidia kelantanensis* Sykes MLLDFF., Nachrbl. D. M. Ges., 1902, p. 139.

This species is notable for the angular lamella, which converges to and joins the parietal, as shown in pl. 35, fig. 10.

Figures 10, 11 are from one of the original lot. Mr. Sykes figured it as having a small interpalatal plica, no basal and no infraparietal (fig. 12). Probably the basal and infraparietal are variable. It is related, though not closely, to *G. crossei* and its group, and to the Javan *B. boettgeri.*

14. BOYSIDIA BOETTGERI Moellendorff. Pl. 34, figs. 7, 8.

Shell narrowly perforate, irregularly conic, rather solid, subpellucid, delicately striatulate, opaque, as though frosted, brown. Spire pyramidal, the sides straight, apex obtuse.

Whorls 6, convex, the last strongly ascending in front. Aperture inclined a little backward, obliquely subcordiform, peristome continuous, appressed above, rather well expanded, brown-lipped, the outer margin sinuous, provided wth a tooth-like callous above. Parietal lamellæ three, the right one low, attaining the margin, the middle one shorter, strongly elevated, he third one short, tooth-like; columellar lamella strong, horizontal; palatals 4, of which the median 2 are stronger, opposite to the columellar and median parietal, in form of a cross. Diam. 2.33, alt. 3 mm. (*Mlldff.*).

Java (Fruhstorfer): Soekaboemi.

Boysidia boettgeri Mlldff., Nachrbl. d. Mal. Ges., vol. 29, June, 1897, p. 70.

By its long, parallel angular and parietal lamellæ (fig. 7) this species is related to the far smaller *B. paviei.* In other characters it approaches *B. kelantanensis* somewhat.

The entire surface is most minutely, densely granulate, with only faint, sparse traces of growth-lines; it is opaque and cinnamon-brown, but varying a little in shade. The aperture is nearly vertical, its length diagonal to the axis. Peristome is continuous, the parietal margin being thickened and raised but not free, arching well up on the face of the whorl. Nine or ten teeth. The angular lamella is very long, nearly parallel to the stouter parietal; infraparietal short. There are usually some low wrinkles on the parietal callous (fig. 7). The columellar lamella is horizontal. There is a subcolumellar below it. The plicæ vary somewhat, but in most shells examined there are rather large, subequal upper and lower palatals, with smaller basal, infrapalatal and suprapalatal plicæ, the last usually concealed behind the stout tubercle which terminates the lip-callous, at the upper third of the outer lip. The teeth are granulose but not spiniferous. Alt. 3, diam. 2.25 mm.

It may be convenient to mention that specimens of this species have been received here, and doubtless by other museums, under the names *Boysidia moellendorffi* Bttg., *B. javana* Mlldff. and *B. boettgeri* Mlldff., all for exactly the same form. Only the last name has been published. Part of those seen (and probably all) were collected by Fruhstorfer.

Genus GYLIAUCHEN Pilsbry.

Gyliauchen Pils., this vol., p. 174, July 18, 1917.

The shell is umbilicate, with conic spire of 4 to 5 whorls, the last whorl straightened, becoming free, produced or ascending, as in *Hypselostoma*. Peristome is expanded. The *angular and parietal lamellæ are independent and parallel.* The plicæ and lamellæ are minutely spinulose.

Type: *Hypselostoma hungerfordiana* Mlldff.

Distribution: Tonkin and Ava to Kalao and Tenimber.

This genus differs from *Hypselostoma* by having an angular lamella distinct from the parietal, and by the microscopic spinules with which the lamellæ and plicæ are set. They are most conspicuous on the smaller teeth. *Gyliauchen* is much more closely related to *Paraboysidia*, being merely a further development of that group, differentiated by the produced and partly free last whorl.

There cannot be any doubt that *Gyliauchen* and *Hypselostoma* are two independent derivatives from Boysidioid ancestors, their resemblance in shape being due to parallel modification in the two series.

Key to Species of Gyliauchen.

a. Surface minutely rugose or granulose; an excavation or concavity between the upper and lower palatal plicæ.

b. Last whorl not ascending, shortly free, the upper margin of aperture advanced forward of the lower; alt. 2.6, diam. 2.7 mm. Samui I. *G. transitans*, no. 3.

b^1. Last whorl ascending somewhat, the aperture looking upward slightly, the basal margin advanced.

c. Diam. 2.5 mm.; spirally striolate. Samui I. *G. striolatus*, no. 4.

c^1. Diam. 3 mm. or more; surface granulose.

d. Neck long; aperture with several lamellæ between the parietal and columellar. Perak. *G. hungerfordianus*, no. 2.

d^1. Neck moderate or short; aperture distinctly looking upward.

e. Pale-colored; only one infraparietal lamella. Ava.
G. bensonianus, no. 1.

*e*¹. Dark brown. Tonkin.
G. crossei, no. 5.

*a*¹. Sculpture of spiral threads or striæ; space between the two palatal plicæ nearly flat, not excavated.

b. Last whorl excavated or concave below the periphery; umbilicus wide; spiral striation rather coarse.

c. Very broadly umbilicate. Kalao.
G. everetti, no. 7.

*c*¹. Moderately umbilicate. Tenimber I.
G. dohertyi, no. 8.

*b*¹. Last whorl flattened but not excavated below the periphery; umbilicus narrow; spiral striation fine and close. Java. *G. fruhstorferi*, no. 6.

Series of G. crossei.

Periphery having a rounded keel, a concavity above it; surface minutely granulose; a concavity between the palatal plicæ.

1. GYLIAUCHEN BENSONIANUS (Blanford). Pl. 37, figs. 11, 12.

Shell moderately umbilicated, turbinate, not distinctly striated, thin, horny. Spire conical, apex papillar and with the axis oblique, suture deep. Whorls 4, the upper ones flattened, the last bulging below the suture, and again at the periphery (where it bears a prominent rounded keel), rounded beneath, and compressed towards the umbilicus. It rises somewhat towards the mouth, which is round, nearly vertical, slightly turned upwards, free from the other whorls, and furnished inside with five lamellar teeth, four of which are equidistant and opposite to each other at the upper and lower corners of the mouth, so as to form a partial St. Andrew's cross, while the fifth, which is smaller, is close to and above that at the upper corner of the parietal margin. Peristome free, simple, broadly expanded and trumpet-shaped. Major diam. 3, minor 2.2, alt. 2 mm.; diam. of peristome 1 mm. (*Blanford*).

Ava: Mya Leit Doung.

Hypselostoma bensonianum BLANFORD, Journ. As. Soc. Beng., vol. 32, 1863, p. 326.—PFR., Monogr., v, 437.—HANLEY & THEOBALD, Conch. Indica, 1870, pl. 8, f. 2. — GUDE, Fauna Brit. India Mollusca, ii, p. 299.

The differences between this shell and *Hypselostoma tubiferum* Benson, hitherto the only known species of the genus, are numerous. That shell has the spire scarcely exserted, while the last whorl ascends so much that the mouth, which is horizontal is on a level with the apex. In the present species the spire is conical, the mouth nearly vertical, and the last whorl only ascends very slightly (*Blanford*).

"Some specimens in the Theobald collection measure: major diam. 3, min. 2, alt. 2 mm. (including the peristome)" (*Gude*).

The angular and parietal lamellæ are parallel, not converging, both being rather short and slender. Infraparietal is minute, rather deeply placed. Columellar lamella rather small. Upper and lower palatal plicæ are well developed, the lower somewhat larger. Basal fold small. The last whorl runs up more, and the free part is not so long as in *G. hungerfordianus*. Fig. 12 is from *Conchologia Indica*, fig. 11 from a specimen in mus. A. N. S.

2. GYLIAUCHEN HUNGERFORDIANUS (Moellendorff). Pl. 36, figs. 1-4.

Shell rather openly umbilicate, turbinate, thin, corneous-brown, opaque. Whorls 4½, angulate-convex, separated by a much impressed suture, slightly striatulate, the upper forming a concave, turrited-conic spire with mamillar, slightly excentric apex. Last whorl having a projecting, rounded keel at the periphery, another more obtuse one at the umbilicus, encircled by lightly impressed spiral sulci above and below the peripheral keel; its last fourth free, running forward, slightly ascending, almost tetragonal in the free part, at the base spirally lineolate. Aperture nearly vertical, very slightly looking upward, rounded-quadrangular, contracted by seven lamelliform teeth within, of which four larger form a cross;

parietal strong, deeply entering, bipartite; between it and the columellar there are three smaller ones. Peristome free, simple, thin, rather broadly expanded, rather deeply sinuated between the two lamellæ. Diam. max. 3, alt. 2½, diam. of aperture with peristome 1 mm. (*Mlldff.*).

Perak: Bukit Poudong (R. Hungerford); Kelantan (Sykes).

Hypselostoma bensonianum v. Mlldff., Journ. Asiat. Soc. Beng., vol. 55, pt. 2, 1886, p. 306. — *Hypselostoma hungerfordianum* v. Mlldff., Proc. Zool. Soc., 1891, p. 337, pl. 30, f. 7, 7*a*.—Sykes, Journ. of Malacology, ix, p. 61.

"Although I have not yet been able to compare authentic specimens of *H. bensonianum* Blfd. from Ava, I am convinced that the Perak form cannot be combined with it and that it constitutes a good new species. It is somewhat more conical and comparatively higher than the Ava form, the upper whorls are more convex, not 'planulate' as Blanford has it, the last whorl is more detached and stretches to the right; facing the shell the whole aperture is visible in *H. bensonianum*, only part of it in *H. hungerfordianum*. There are seven instead of four teeth. I suppose that the additional fifth tooth mentioned by Blanford means that the parietal tooth or lamella is divided as in the Perak species, but the latter possesses three more between the parietal and columellar lamellæ" (Mlldff.).

The angular lamella is very slender and runs close and parallel to the anterior part of the parietal (fig. 4). The two infraparietals are long and larger than the supracolumellar lamella. Upper and lower palatal plicæ strong, some small interpalatals between them. In the basal position are one or more little plicæ. All the lamellæ and plicæ are seen to be set with minute points. Under a low power they seem as if covered with little sand grains.

The surface is minutely and superficially rugose. Apex is minutely granulose. The peristome is flatly reflected along the columellar margin, the outer merely expanded.

This species has a longer, less ascending neck and more developed accessory plicæ and lamellæ than *G. bensonianus*. It is paler than *G. transitans*, has a longer neck, longer angular lamella and more teeth.

Specimens from the limestone caves of Gunong Pondok (pl. 36, fig. 1) have the scaly-granose sculpture strongly developed and the keel more pronounced. The figured specimen measures, alt. 2, diam. 3 mm. Figures 2-4 are Perak specimens, probably of the original lot.

3. GYLIAUCHEN TRANSITANS (Moellendorff). Pl. 36, figs. 5-8.

Shell umbilicate, turbinate, obliquely striatulate, brown. Whorls 4, convex, forming a conic spire with papillar apex; the last whorl a little distorted, not ascending in front, shortly free and produced forward, at the periphery encircled with a rather prominent crest, another smaller one at the umbilicus; the base somewhat swollen, compressed around the umbilicus. Aperture slightly oblique, rounded-tetragonal; peristome coninuous, thin, expanded, hardly reflected. Parietal lamella rather strong, bifid in front; two teeth in the outer margin, one in the base and one on the columella. Diam. 2.75, alt. 2.66 mm. (*Mlldff.*).

Samui Is. (C. Roebelen).

Hypselostoma transitans MLLDFF., Proc. Zool. Soc., 1894, p. 16, f. 12, 13.

"This peculiar shell presents an especial interest, inasmuch as it forms a decided transition from *Hypselostoma* to the Indian and Chinese *Boysidia* Ancey, of which *Pupa hunanensis* Gredl. is the type. As I have mentioned in the description of *Hypselostoma hungerfordianum* (P. Z. S., 1891, p. 338) the genus appears to be but an extreme development of the *Boysidia* type. *Boysidia strophostoma* Mldff. of South China shows already a slight distortion and detachment of the last whorl, which in the Samui species is much less developed than in the other forms of the genus. There can be no doubt, however, that it belongs to *Hypselostoma*, with which it has the peculiar quadrangular shape of the last whorl and the dentition of the aperture in common. *H. crossei* Mor. of Tongkin seems to connect it with the other Malayan species" (*Mlldff.*).

The angular lamella is quite short and parallel to the parietal, but distinct from it (fig. 5); the two palatal plicæ are about equal, the basal plica much smaller. The last whorl is

straight or even descends a little in front, and the aperture is a little oblique, the upper margin of the peristome advancing further than the lower, in this respect differing from the related species, which look upward. In the somewhat similar *G. crossei* the lower margin is advanced, as usual.

The surface is closely sculptured with short wrinkles, or they might be called long, irregular, coarse granules. The first whorl is distinctly granulous. This sculpture is only visible under the compound microscope. The original figures are reproduced in figs. 6 and 7.

The Samui Islands, in the Gulf of Siam, are a small group south of Bangkok and situated near the coast of the Malay Peninsula at its narrowest part. It consists of several small islands, the largest of which is called Samui. The rock seems to be calcareous throughout.

4. Gyliauchen striolatus (Moellendorff).

Owing to the bad state of preservation of the two specimens of this form, quite distinct from the preceding one, I cannot give a complete description of it. Its last whorl is much more detached than in *H. transitans* and distinctly bent upwards, and shows very distinct though minute spiral lines. The diameter is only 2.5 millim. It belongs to the group of *H. bensonianum* and *H. hungerfordianum* (*Mdllff.*).

Hypselostoma striolatum Mlldff., Proc. Zool. Soc. Lond., 1894, p. 152.

Samui Is. (Roebelen).

5. Gyliauchen crossei (Morlet). Pl. 36, figs. 9-13.

Shell perforate, conic, of irregular form, small, thin, brown, sometimes lineolate with white, radially, delicately striate. Spire acute; whorls 5, rapidly increasing, separated by a channelled suture, the first smooth, prominent, papillar; the last partly free, carinate in the middle, channelled below and around the umbilicus, subtrigonal, at the end forming a tube. Aperture subtrigonal or subquadrangular, reflexed, brownish, somewhat channelled above, denticulate deep within, the teeth numerous, acute, unequal (4 or 5 larger ones). Umbilicus narrow, deep, angulate at the periphery. Peristome thin, a

little reflected. Diam. maj. 4½, min. 3, aperture 2 mm. long and wide (*Morlet*).

Tonkin: montagne de l'Éléphant (Jourdy).

Hypselostoma crossei MORLET, Diagn. de Mollusques terr. et fluv. du Tonkin, 1885, p. 2; Journ. de Conchyl., vol. 34, 1886, pp. 259, 275, pl. 12, f. 5-5*c*.—*Hypselostoma crossei* subsp. *endodonta* and *brevituba* MLLDFF., Nachrbl. D. Malak. Ges., 1901, p. 76.

This species is distinguished by its dark color, thickened peristome and numerous accessory teeth.

Two of Morlet's figures are copied, pl. 36, figs. 9, 10. Specimens from near Haiphong, received from M. Dautzenberg, are drawn in pl. 36, figs. 11-13. The color is dark vinaceous-brown or almost chocolate, uniform or with some whitish lines, the spire paler, more tawny; the aperture being vinaceous-russet. There are 4⅓ whorls, at first strongly convex, the penult less so. The last whorl is convex below the suture, in its last half either strongly or weakly excavated above the strong peripheral angle; also within the rounded angle which bounds the umbilicus. The neck ascends a little and is nearly circular in section, but the supraperipheral furrow persists, also one above the parietal wall. The length of the free neck varies; it is often very short. The aperture looks upward a little, and when most fully toothed has: a small, narrow but long angular lamella, which bears a whitish lump near its outer end; a strong high and straight parietal lamella; two low, obtuse, rather long infraparietal lamellæ; a horizontally entering, downward-bent columellar lamella (all of these shown in fig. 11); a small supracolumellar above the columellar, and one or two below it. The basal region is occupied by two or three minute plicæ; upper and lower palatal plicæ well developed, the lower larger, as usual; between them, and above the upper, there are several inter- and suprapalatal plicæ, the latter often continuing as far as the angular. The angular, parietal and columellar lamellæ, upper and lower palatal plicæ are constant, but the number of small accessory teeth varies with every specimen. All of them are set with many short points or prickles. The peristome is widely re-

flected, thin at the edge, and rather strongly calloused within, the teeth being placed further inward than the callous.

Alt. 2.75, greatest diam. 3.6 mm.

Alt. 2.55, greatest diam. 3.5 mm.

5*a*. *G. c. endodonta* Mlldff.

Umbilicus a little wider, spire a little less elevated, apex more oblique, last whorl a little less free, teeth much more deeply placed. Diam. 3.4, alt. 2.3 mm. (*Mlldff.*).

Tonkin: Lang-son (Fruhstorfer).

5*b*. *G. c. brevituba* Mlldff.

Last whorl very much more shortly free, spire higher. Diam. 3.1, alt. 2.5 mm. (*Mlldff.*).

Series of G. everetti.

Surface spirally striate; space between the upper and lower palatal plicæ flat, not excavated.

6. GYLIAUCHEN FRUHSTORFERI (Moellendorff). Pl. 37, figs. 1, 2, 3.

Shell narrowly umbilicate, irregularly trochiform, rather solid, somewhat pellucid, delicately striatulate, decussated with very fine, extremely close but distinct spiral lines, opaque, brown. Spire rather high, subregularly conic. Whorls 4½, very convex, separated by a deep suture, the last angular in the middle, then flattened, angular again around the umbilicus, moderately ascending in front, shortly free, contracted behind the aperture, then bell-shaped. Aperture slanting backward, rounded-pentagonal; peristome continuous, narrowly spreading. Two parietal lamellæ, the angular nearly reaching the margin, the other receding, strongly elevated; columellar deep; 6 palatals, of which two are larger, long, opposite to the parietal and columellar lamellæ, in form of a cross. Diam. 2.5, alt. 2.25 mm. (*Mlldff.*).

Java (Fruhstorfer).

Hypselostoma fruhstorferi MLLDFF., Nachrbl. d. Mal. Ges., vol. 29, June, 1897, p. 70.

It is more elevated than *everetti* and *dohertyi*, darker, more

minutely striate spirally, not excavated below the periphery, and has a smaller umbilicus. A certain latitude of variation is to be expected in the secondary denticles in all Pupillidæ, but *fruhstorferi* has more than its immediate allies.

The inner half of the long angular lamella is quite low. Columellar lamella and upper and lower palatals are subequal, all long and straightly entering. In the specimen figured the secondary or minor teeth are as follows: a rather well-developed infraparietal; small supra- and subcolumellars; two small folds in the base, one interpalatal, and several minute ones in the sinulus. All of the lamellæ and plicæ are microscopically spiniferous.

The color is prussian red or somewhat lighter, being darker than the related species. Apex is minutely granulous, the subsequent whorls delicately striate spirally, the spiral threads much finer and closer than in *everetti*. Alt. 2.1, diam. 2.5 mm.

7. GYLIAUCHEN EVERETTI (E. A. Smith). Pl. 37, figs. 4-6, 10.

Shell minute, openly, perspectively umbilicate, brown, minutely decussated with growth and spiral striæ; spire small, elevated. Whorls 4, convex, separated by a deep suture, the apical large, last whorl concave about the middle, obtusely angular above and around the umbilicus, free and ascending in front, pitted towards the aperture. Aperture tube-like, armed with several teeth within; peristome pale reddish, thin, expanded, triangular-rounded. Diam. maj. 3, min. 2, alt. 1½ mm., aperture 1 mm. wide (*Smith*).

Kalao Island, between Celebes and Flores (A. Everett).

Hypselostoma everetti SM., Ann. and Mag. N. H. (6), xviii, August, 1896, p. 148, pl. 10, f. 9-9*b*.

"In a natural condition all the shells are covered more or less with agglutinated earth, which produces a rough irregular appearance. There are five principal converging teeth within the aperture, and a few smaller intermediate ones, none reaching to the edge of the labrum.

"A species from Java in the British Museum labeled *H. Fruhstorfer* Bttgr. somewhat resembles the present form; it

is, however, larger, has the last whorl less freely produced, is keeled at the middle, and the spire is more elevated'' (*Smith*).

The angular lamella is very long, reaching nearly to the edge of the lip; parietal also long but deeply immersed, its front end projecting shortly in front of the inner end of the angular. Upper and lower palatals and columellar lamella are about equal. The large, vinaceous-russet or pale brown first whorl is beautifully granulose, the later whorls having strong spiral threads crossed by irregular, lower growth-wrinkles. Alt. 1.5, diam. 2.7 mm. or somewhat smaller.

It is a remarkable little shell. Mr. Smith's figure (copied in fig. 10) represents one of the lowest examples. Some others are higher, as in fig. 5. It is closely related to the following species.

8. GYLIAUCHEN DOHERTYI (Fulton). Pl. 37, figs. 7, 8, 9.

Shell dextral, triangular, umbilicus deep and moderately wide, almost smooth; whorls 4, first three small, convex, body-whorl large, somewhat depressed in the center and keeled above and below, slightly ascending; interior of aperture armed with five teeth, two on parietal wall, two palatal teeth, and one on the columellar side of the aperture; peristome subcircular, expanded, continuous. Diam. maj. 2.75, alt. 2 mm. (*Fulton*).

Tenimber Island (Wm. Doherty).

Hypselostoma dohertyi FULTON, Proc. Malac. Soc. Lond., iii, March, 1899, p. 215, pl. 11, f. 17.

Allied to *H. everetti* Smith from Kalao Island, but this species is narrower, the aperture does not project so far from the body-whorl, it is more closely coiled below, and is not perspectively umbilicated (*Fulton*).

The aperture has a triangular, somewhat trefoil shape. The angular lamella is long, but the inner half is quite low; it does not reach nearly to the edge in front. Parietal lamella long and straight. The columellar lamella and upper palatal plica are about equal, the lower palatal somewhat longer; all enter directly. There are quite small basal, subcolumellar and infraparietal teeth, and some smaller ones on the borders

of the sinulus. All of these small accessory teeth are probably variable in development. All of the teeth are minutely spiniferous, especially the smaller ones.

The external sculpture resembles that of *G. everetti*, but the spiral threads are not so conspicuous, though rather coarse, and growth-striæ are hardly noticeable. Figured from cotypes, one of which measures, alt. 1.8, greatest diam. 2.55 mm.

It differs from *G. everetti* chiefly in the base, as indicated by Mr. Fulton. Compare figs. 4 (*everetti*) and 7 (*dohertyi*).

The Aulacospira and Systenostoma Group.

The lamellæ and folds, when least decadent (as in *Aulacospira azpeitiae*), are unmistakably of Gastrocoptid type; but in most of the species there has been more or less reduction of the armature, terminating in toothless species.

The last whorl often turns a little *towards the axis*, and more or less downward. This contrasts with *Boysidia* and *Hypselostoma*, in which there is more or less *straightening* of the last whorl, which tends to a tangential direction, and in the more evolved forms the aperture looks upward. This antithesis appears to indicate that *Hypselostoma* and related genera on the one hand, *Aulacospira* and *Systenostoma* on the other, form two collateral phyletic series in the *Gastrocoptinæ*.

The species are figured on plate 38.

Genus AULACOSPIRA von Moellendorff.

Aulacospira Mlldff., Bericht Senck. Naturf. Ges. Frankfurt a. M., 1890, p. 224. — Pilsbry, Man. Conch., ix, p. 279, type *A. scalatella*.—*Micropetasus* Mlldff., *l. c.;* same type.

The shell is helicoid, wider than high, small, umbilicate, of thin, corneous texture, unicolored. Spire more or less conic, subscalar and angular peripherally from the mucronate summit; whorls 4 to 5, flattened or with a spiral concavity above the angle, the last whorl sometimes rounded, often shortly free in front, never straightened or ascending. Aperture very oblique, rounded, with 0 to 5 teeth within; the peristome thin, expanded.

Type: *A. scalatella.* Distribution: Philippine Islands.

This group was formerly thought to belong to the Helicidæ. It has apertural dentition entirely of the Gastrocoptid type. The teeth, by their forms and positions, are clearly homologous with those of *Hypselostoma, Gastrocopta* and allied genera, and unlike those found in *Helicidæ*. The genus undoubtedly belongs to the *Pupillidæ*, in the subfamily *Gastrocoptinæ*.

Characters in common with *Hypselostoma* are the angular whorls, more or less sulcate above the angle; the delicate, hair-like spiral striæ, the texture of the shell and the open umbilicus. Conspicuous differential features are the rather descending instead of ascending last whorl, which does not become straightened in its latter part, and the downward-looking, instead of vertical or upturned aperture.

The teeth are more or less decadent in most of the species. *A. azpeitiae*, in which they are well developed, often shows a distinct though small angular lamella joined to the anterior end of the parietal (pl. 38, fig. 17). It has also a columellar lamella, upper and lower palatal and basal plicæ, in the typical positions.

The minute spiral striæ were not mentioned in the original descriptions, but I find them on all of the species except *A. triptycha*, which I have not seen.

Key to Species of Aulacospira.

a. Angle of the last whorl continuing to the aperture; peristome continuous and free (*Aulacospira s. str.*).

b. Aperture toothless; shell very much depressed, alt. 1, diam. 3.2 mm. Cebu. *A. mucronata*, no. 1.

b[1]. Aperture with 1 to 5 teeth; shell less depressed.

c. Trochiform, the spire conic; umbilicus scarcely one-sixth the diameter; an obtuse columellar and sometimes the trace of a parietal lamella. Cebu. *A. hololoma*, no. 2.

c[1]. Shell more depressed; umbilicus wider, contained 4 to 4½ times in diam.

d. An obtuse, low, columellar lamella and sometimes the trace of a parietal; alt. 1.55 to 1.75, diam. 3.1 mm. Ilin, near Mindoro. *A. porrecta*, no. 3.

d^1. Having parietal, columellar and lower palatal teeth; diam. 4 mm. Masbate. *A. triptycha*, no. 4.

d^2. Having 4 or 5 teeth; diam. about 3 mm.

e. A minute basal fold present. Luzon. *A. scalatella*, no. 5.

e^1. No basal fold. Tablas. *A. rhombostoma*, no. 6.

a^1. Last whorl rounded peripherally, not free in front; aperture with 5 (or 6) teeth; peristome not continuous. (Subg. *Pseudostreptaxis*.) Busuanga. *A. azpeitiae*, no. 7.

1. AULACOSPIRA MUCRONATA (Mlldff.). Pl. 38, fig. 1.

See Man. Conch., vol. 8, p. 199. This is the most depressed species, further distinguished by its toothless aperture. It is from the west coast of Cebu.

2. AULACOSPIRA HOLOLOMA (Mlldff.). Pl. 38, figs. 6, 7.

See Man. Conch., vol. 8, p. 198. Distinct by its trochoidal form and narrow umbilicus. There are 4½ whorls, not 5½ as stated by von Moellendorff, and repeated in vol. 8. Besides the low columellar lamella, there is sometimes a low callous ridge representing the parietal lamella. A specimen measures: Alt. 2.1, diam. 3.4 mm.; umbilicus 0.5 mm.

Peak of Mt. Licos, Cebu.

3. AULACOSPIRA PORRECTA Quadras et Moellendorff. Pl. 38, fig. 2.

The shell is openly umbilicate, conoid-depressed, thin, delicately striatulate, brownish-corneous. Spire shortly conoid, terraced. Whorls 4, flattened, keeled with an obtuse, but little projecting keel, lightly furrowed above the keel. Last whorl with the base a little convex; shortly bent down and free. Aperture diagonal, ellipsoidal; peristome continuous, very narrowly expanded throughout. Alt. 1.25, diam. maj. 3, min. 2.66 mm. (*Mlldff.*).

Philippines: Ilin Island, near Mindoro.

Aulacospira (Micropetasus) porrecta Q. et MLLDFF., Nachrbl. D. Malak. Ges., xxvi, June, 1894, p. 95.

All of the specimens seen have a columellar lamella. It is very blunt and low, not lamelliform, being a rather diffuse tubercle. There is also, in some examples, a low callous ridge representing the parietal lamella. As in the other angular species, there is a microscopic sculpture of spiral lines. It resembles *A. hololoma* in teeth, but not in shape.

4. AULACOSPIRA TRIPTYCHA Quadras & Moellendorff.

The shell is rather openly umbilicate, discoidal, thin, delicately sculptured with arcuate, fold-like striæ. Spire shortly conoid, somewhat terraced. Whorls 4½, flattened, nearly free at the deep suture, the last whorl obtusely keeled at the periphery, slightly impressed above the keel, nearly flat at the base. Aperture almost horizontal, obliquely oval, having three teeth: one on the parietal, one basal and one horizontal, lamelliform columellar. Peristome continuous, appressed above, the upper margin straight, outer and basal narrowly expanded, columellar margin somewhat reflected. Alt. 1.75, diam. 4 mm. (*Mlldff.*).

Philippine Is.: Mt. Bathuan, near the village of Palanoc, island of Masbate.

Aulacospira triptycha Q. et M., Nachrbl. D. Malak. Ges., xxvii, June, 1895, p. 76.

The "basal" tooth mentioned is evidently the lower palatal plica, which is situated rather low in this genus. I have not seen the species, and it has not been figured.

5. AULACOSPIRA SCALATELLA Moellendorff. Pl. 38, figs. 8. 9.

See Man. Conch., vol. 8, p. 199; vol. 9, pl. 64, figs. 10-12. This species has five teeth: the parietal and columellar lamellæ, upper and lower palatal plicæ, and a small basal fold. The columellar lamella ascends obliquely. A specimen measures, alt. 1.5, diam. 2.9 mm.

Village of Antipolo, Manila Province, Luzon.

6. AULACOSPIRA RHOMBOSTOMA Moellendorff. Pl. 38, fig. 13.

The shell is moderately but openly umbilicate, conoid-depressed, thin, delicately striatulate, opaque, corneous-buff; spire moderately elevated, somewhat terraced, the apex ob-

lique, somewhat mucronate. Whorls 4, nearly flat, obtusely angular, the last slightly sulcate above behind the angle, shortly descending in front, and very shortly free. Aperture very oblique, rounded-rhombic; peristome continuous, thin, slightly expanded throughout. Parietal lamella strong, much elevated, three teeth arranged in form of a cross on columellar, basal and outer margins. Alt. 1.5, diam. 3.25 mm. (*Mlldff.*).

Philippines: Tablas, taken by a native collector.

Aulacospira rhombostoma Mlldff., Nachrbl. D. Malak. Ges., xxviii, Feb. 1896, p. 8.

Very near *A. scalatella*, but larger, with the last whorl descending less to the aperture. There is no basal fold, but the lower palatal is almost basal in position, as in other species having that plica. There are microscopic spiral lines, as in the related species. A specimen measures, alt. 1.8, diam. 3.3 mm.; another is 3.1 mm. in diameter.

Subgenus *Pseudostreptaxis* Mlldff.

Pseudostreptaxis Mlldff., Bericht Senck. naturf. Ges., 1890, p. 225.

7. Aulacospira azpeitiae (Hidalgo). Pl. 38, figs. 14, 17.

See Man. Conch., vol. 8, p. 199. The obtuse angle of the penult whorl projects above the rounded last whorl. Besides the four teeth of the typical Aulacospiras, this species has a small basal fold, as in *A. scalatella*, and usually an angular lamella can be recognized, though in some examples it is pretty thoroughly united with the parietal lamella. Alt. 2.4, diam. 3.2 mm.

Philippines: Busuanga.

Genus SYSTENOSTOMA Bavay & Dautzenberg.

Systenostoma B. & D., Journ. de Conchyl., lvi, 1909, p. 243; lvii, p. 196; lx, p. 23.

The shell is helicoid, minute, thin, umbilicate, with conoid spire and mucronate apex; composed of 4½ to 5 convex, not carinate whorls, the last one turning slightly towards the axis. The aperture is turned more or less downward, sub-

circular, oblique and toothless; peristome thin, free or very shortly adnate, expanding very little.

Type: *S. pauperrima.*

Distribution: Tonkin, Indo-China.

Figured on plate 38. This genus was at first thought to be Helicid. Subsequently Messrs. Bavay and Dautzenberg wrote: "A close examination of the four forms leads us to think now that the genus *Systenostoma*, which we placed among the Helices, belongs to the Pupæ, and is to be put in the neighborhood of *Hypselostoma* and *Boysidia;* the Systenostomas being, if we may so express it, toothless Boysidias. These mollusks live on rocks, probably subsisting upon the lichens with which they are draped."

My knowledge of *Systenostoma* is wholly from the writings of Bavay and Dautzenberg, translated below, from which I get the impression that it is closely related to *Aulacospira.* It differs by having the whorls rounded instead of keeled, and the lip less expanded, almost simple.

1. SYSTENOSTOMA PULVEREA (Bav. et Dautz.). Pl. 38, figs. 10, 11, 12.

The shell is very small, thin, umbilicate; spire conoid. Whorls 4½, convex, terraced, rapidly increasing, ornamented with delicate, oblique lines of growth, and very delicate spiral lines, only visible under a very strong lens. The last whorl is carried towards the axis. Umbilicus moderate. The aperture is oblique, subrotund; peristome simple, very slightly thickened, free almost throughout, but dilated and adnate on the penult whorl, a little reflected at the umbilicus. Color dull pale gray, dirty with agglutinated dust. Alt. 2.5, diam. maj. 2.5, diam. aperture 1.5 mm. (*B. et D.*).

Tonkin: Phu-Quoc-Oai, on rocks (M. Demange).

Helix (Systenostoma) pulverea BAVAY et DAUTZENBERG, Journ. de Conchyl., lvi, 1909, p. 243; lvii, p. 194, pl. 8, f. 7-9.

2. SYSTENOSTOMA PAUPERRIMA (Bav. et Dautz.). Pl. 38, figs. 3, 4, 5.

The shell is very small, conoid, apiculate (the embryonic 1½ whorls forming a nearly cylindric apex), umbilicate. Five

quite convex whorls, slowly increasing, without any trace of sculpture; the last whorl shortly descending quite suddenly at the end and contracted behind the peristome. Aperture oblique and irregularly rounded, turned in towards the axis. Peristome continuous, simple, detached, very slightly thickened and reflected. Color dirty white, all the specimens being dead and discolored. Alt. 2, width 1.5 mm. (*B. & D.*).

Tonkin: Phu-Quoc-Oai, in shell debris (M. Demange).

Helix (Systenostoma) pauperrima Bavay & Dautzenberg, Journ. de Conchyl., lvi, 1909, p. 243; lvii, p. 195, pl. 8, f. 4-6.

3. Systenostoma defixa Bav. et Dautz. Pl. 38, figs. 15, 16.

The shell is very small, broadly and perviously umbilicate, depressed conic, the base strongly dilated. Spire conoid, moderate. Five convex whorls, joined by an impressed suture, smooth and buff. Last whorl is very large, slightly subangular at the periphery, and descending towards the end. The aperture is very oblique, slightly detached, subcircular, flattened above; peristome simple, continuous, slightly dilated. Color very pale yellow, darker towards the apex. Alt. 1, greatest diam. 1.6 mm; diam. aperture ⅔ mm. (*B. & D.*).

Indo-China: Table Island, Bay of Along (M. Demange).

Systenostoma defixa Bavay & Dautzenberg, Journ. de Conchyl., 1912, p. 22, pl. 1, f. 18, 19.

"This little species, like the two others of the same genus described by us, has the appearance of a young shell. A fourth species represented by a single example, really not adult, will not be described at this time."

Genus BOTHRIOPUPA Pilsbry.

Bothriopupa Pils., Nautilus, xi, 1898, p. 119, for *Vertigo variolosa.*

The shell is minute (known species 1½–2 mm. long), perforate, ovate-conic, of about 4½ convex whorls; surface *minutely and densely pitted, or granulose* by confluence of the pits, hardly or not striate. Aperture broadly truncate above, the lip-insertions remote; outer lip slightly, the columellar broadly expanded. Parietal lamella median, curved; a short,

horizontally entering columellar lamella and submarginal upper and lower palatal plicæ usually present, angular lamella rarely developed. Type *B. variolosa* (Gld.).

Distribution: tropical America.

Illustrated on plates 28, 29. This small group of very rare snails is probably to be regarded as a simplified derivative of Gastrocopta in which the angular lamella has been reduced or lost, and the lower palatal plica is nearly basal in position and submarginal, not more deeply placed, as in *Gastrocopta*. I am led to this view by the structure of *B. geminidens*, which retains an angular lamella like *Gastrocopta*, while the rest of the structure is that of *Bothriopupa*, and especially by *B. tenuidens*, which sometimes has a well-developed though short angular lamella, shown in pl. 29, figs. 12, 13. Moreover, the species show several stages in the decadence of teeth, suggesting that the ancestral form was a well-toothed Pupillid which is evolving towards a *Pupisoma*-like form.

The pitted or pock-marked surface of these species is highly characteristic in the American series of Pupæ, but it is matched in the *Nesopupa* group, which in other respects does not seem closely related to *Bothriopupa*. Most of the Bothriopupæ have reached about the same stage of tooth-reduction as *Gastrocopta quadridens;* some have gone further. In teeth, but not in sculpture, *Bothriopupa* resembles the East Indian group *Costigo*.

From the shape of the shell and its rarity in gatherings of ground debris, I suspect that *Bothriopupa* will prove to live on shrubs or on leaves, with the exception perhaps of *B. geminidens*. The single species which I have collected was found dead on the ground. I would suggest beating foliage over an inverted umbrella, or sweeping as for small insects, as possible methods of collecting.

Probably these small snails will turn out to be widely and generally spread in tropical America, when adequate attention is given to the minute shells, and their station is discovered.

This genus should have been inserted immediately after *Gastrocopta*, but was omitted by oversight.

Key to Species.

a. Parietal wall having an angular lamella joined to the parietal. *B. geminidens*, no. 1.

a^1. Parietal wall having a small angular lamella remote from the parietal. *B. tenuidens*, no. 2.

a^2. Parietal wall bearing a simple parietal lamella only.

b. Without palatal plicæ. *B. leucodon*, no. 6.

b^1. One or two palatal plicæ present.

c. Four-toothed, having parietal and columellar lamellæ and two palatal plicæ.

d. Teeth large. *B. tenuidens*, no. 2.

d^1. Teeth small. *B. breviconus*, no. 3.

c^1. Three-toothed, no upper palatal plica present.

d. Outlines of spire strongly convex; Florida. *B. variolosa*, no. 4.

d^1. Outlines less convex, spire more conic; Demerara to Venezuela. *B. conoidea*, no. 5.

1. BOTHRIOPUPA GEMINIDENS n. sp. Pl. 28, figs. 12, 13, 14.

The shell is oblong-conic, perforate and shortly rimate, pale corneous, thin and fragile, composed of 4¼ whorls, which are strongly convex. The surface is seen under the microscope to be minutely granulose, and in life is daubed with dirt (as in fig. 13). The aperture is squarish with the angles rounded, slightly oblique. Peristome rather broadly expanded on the columellar and basal margins, narrowly on the outer margin. Angular lamella runs from the termination of the outer lip to the parietal lamella, joining the latter near its anterior end. Parietal lamella higher than the angular, somewhat curved (in a basal view, fig. 14). Columellar lamella horizontally entering, from slightly to distinctly leaning downward. The palatal plicæ stand near the margin, the lower being pliciform and larger than the upper, which is tuberculiform. Length 1.5, diam. above aperture 0.95 mm.

Venezuela: Cariaquita (S. Brown). Type and paratypes 105200 A. N. S. P.

This species has a typically Gastrocoptid angulo-parietal

tooth. It differs from *Gastrocopta*, however, by the nearly marginal and sub-basal position of the lower palatal plica, the form of the peristome and the umbilical region, which are all exactly as in *Bothriopupa*, and unlike *Gastrocopta*.

2. Bothriopupa tenuidens (C. B. Adams). Pl. 29, figs. 5-7, 11-13.

Related to *P. ovata* Say, and of the same size; aperture with a large, lamelliform tooth above, running inward; below, another similar but smaller one opposite; two others, one on each side, opposite (*C. B. Ad.*).

The shell is ovate, rather obese, minutely perforate and shortly rimate, cinnamon-colored, thin, composed of about 4½ rather convex whorls. The surface is irregularly, densely pitted. The aperture is somewhat oblique, truncate-oval, the peristome rather broadly expanded on the columellar and basal margins, narrowly so on the outer margin, which is straightened or a trifle incurved in the middle and strongly arched in the upper part. In Jamaican specimens there is the barely perceptible trace of an angular nodule, or none whatever, but in those from Cariaquita, Venezuela (figs. 11-13) the angular is often very distinctly developed, in the typical position, as shown in figs. 12, 13. The parietal lamella is strong, high, and enters rather deeply; it is somewhat curved, the concavity towards the columella (fig. 6). The columellar lamella is smaller, ascending slightly within, but nearly horizontal. The two palatals are pliciform, the lower one longer and more deeply placed. In quite old shells a very low callous pad, which represents the basal plica, may be seen.

Length 1.8, diam. above aperture 1.1 mm.; 4¾ whorls.

Length 1.6, diam. above aperture 1 mm.; 4⅓ whorls.

Jamaica (Adams): Bellevue (Gloyne); near Mandeville, figs. 5, 7, and Somerset, Manchester (A. P. Brown). Cuba (Sterki, as *Vertigo variolosa*). Venezuela: Cariaquita, figs. 11-13 (S. Brown).

Pupa tenuidens C. B. Ad., Proc. Boston Soc. Nat. Hist., 1845, p. 15.—Kuester, Syst. Conchyl. Cabinet, p. 137, pl. 17, f. 25, 26.—Pfeiffer, Monographia, iii, 555; iv, 680; vi, 327.

—Gloyne, Journ. de Conchyl., xxiii, 1875, p. 121.—? *Vertigo tenuidens* C. B. Ad., Poey, Memorias sobre la Hist. Nat. de la isla de Cuba, ii, p. 64.—*Vertigo* (?) *variolosa* Gould, Sterki, Nautilus, iii, 1890, p. 124.

This species is distinguished from *B. variolosa* by having a well-developed upper palatal plica; the lower palatal plica is longer and more deeply entering, and the columellar lamella emerges more. Fig. 7 represents an immature shell.

The specimens from Cariaquita, Venezuela (pl. 29, figs. 11, 12, 13) do not differ materially from those of Jamaica.

Professor Poey's reference can hardly pertain to this species. From Dr. Sterki's notes there can be little doubt that he had *tenuidens* from Jamaica and Cuba, which he identified as *variolosa*. It appears to be rather widely distributed.

3. Bothriopupa breviconus n. sp. Pl. 28, figs. 9, 10.

The shell is globosely ovate-conic, thin, light ochraceous-buff, the surface densely, unevenly pitted; composed of 4⅓ strongly convex whorls. The aperture is irregularly semicircular, oblique, basal and columellar lip expanded, the outer scarcely so. Parietal lamella rather small, curved as seen in a basal view (fig. 10). Columellar lamella small, very slightly ascending inwardly. Lower palatal plica compressed, entering, but short. Upper palatal plica small, tuberculiform. Length 1.5, diam. above aperture 1.15 mm.

Guatemala: mountains west of Livingston (A. A. Hinkley). Type no. 107534 A. N. S. P.

Related to *B. conoidea*, from which it differs by the longer lower-palatal plica and the presence of an upper palatal. It is also a smaller, more delicate and more minutely sculptured shell, with blunter summit and a more globose appearance.

4. Bothriopupa variolosa (Gould). Pl. 29, figs. 2, 3.

Shell very small, ovate-conic, rufous, subperforate, closely indented; whorls 4-5, swollen; suture deep; aperture obliquely semioval, armed with a columellar tooth, another on the lip, another lamellar one posteriorly; lip slightly reflected. Length one-twelfth of an inch (*Gld.*).

The ovate shell is composed of about 4½ convex whorls.

The surface is very closely pitted, or in some specimens the pits are confluent, so that it appears covered with a very irregular granulation. The aperture is somewhat oblique, peristome expanded, not thickened, whitish. The parietal lamella is very high and rather long, curved. Columellar lamella small and placed far within. The lower palatal plica is tuberculiform and nearly basal in position. There are no other teeth.

Length 1.8, diam. above aperture 1.25 mm.

Length 1.7, diam. above aperture 1.1 mm.

Florida (Bartlett): southeast point of Big Pine Key (Pilsbry); Little Marco, Lee Co.; and Horr's Island, near Key Marco (C. B. Moore).

Pupa variolosa Gould, Proc. Boston Soc. N. H., iii, 1848, p. 40; in Binney's Terr. Moll. U. S., ii, p. 331, pl. 72, f. 2.—Pfeiffer, Monogr., iii, 556.—Binney, Terr. Moll., v, 1878, p. 199.—*Vertigo variolosa* (Gld.), Pilsbry, Nautilus, xi, p. 119.

This is one of the rarest Pupas; yet, from the records at hand, it will probably be found throughout the peripheral keys. The absence of an upper palatal plica, the short lower-palatal, and the smaller columellar lamella distinguish it from *B. tenuidens* throughout the series of each examined. The pitting was very poorly represented in Gould's figure.

5. Bothriopupa conoidea (Nc., Pfeiffer). Pl. 28, figs. 7, 8, 11.

"Shell perforate, globose-conic, thin, striatulate, diaphanous, little shining, brown; spire conoid, the apex obtuse. Whorls 4½, convex, the last one-third the length, rotund at base. Aperture a little oblique, semicircular, toothless; peristome simple, a little expanded, the columellar margin somewhat dilated, broad. Length 1½, diam. 1 mm. In perfect specimens there are two plicæ, one parietal, the other transverse, on the columella" (*Pfr.*).

Demerara (Newcomb); Cariaquita, Venezuela (S. Brown, 1911).

Pupa conoidea Newcomb Mss., Pfeiffer, Monographia Hel. Viv., iii, 1853, p. 533; Proc. Zool. Soc. Lond., 1852, p. 70

(May, 1854); Monogr., iv, 667; vi, 307. — KUESTER, Syst. Conch. Cab., p. 174, pl. 21, f. 6, 7.

This species stands very close to *B. variolosa*, but *its outline is more conic*, and the teeth are perhaps not quite so large. Pfeiffer did not see the small lower palatal plica, but it was described and figured by Kuester, who worked with Pfeiffer's specimens, and it is present in paratypes received from Newcomb.

As in *variolosa*, the columellar lamella is far within the margin. It has the same sculpture described for *variolosa*. Figured from specimens received from Newcomb, one of which measures: length 1.8, diam. above aperture 1.2 mm. (figs. 8, 11).

A specimen from Cariaquita is drawn in fig. 7; length 1.5, diam. 1.15 mm.

6. BOTHRIOPUPA LEUCODON (Morelet). Pl. 29, figs. 1, 4.

Shell deeply rimate, ovate-conic, rather obtuse, slightly striatulate, pellucid, corneous; whorls 5, a little convex. Aperture oblong-subcircular, with a pliciform, angular, whitish tooth erect in the middle of the parietal wall. Length 2, diam. 1 mm. (*Morelet*).

Guatemala: Salama, in the province Vera Paz (Morelet).

Pupa leucodon MORELET, Testacea Novissima, ii, 1851, p. 13.—PFR., Monogr., iii, 537.—CROSSE et FISCHER, Moll. Terr. et Fluv. Mexique et dans l'Amér. Centr., i, p. 311, pl. 14, f. 2.

THE ABIDA GROUP.

The genera *Odontocyclas, Sandahlia, Abida, Granopupa* and *Chondrina* in Europe and northern Africa, *Fauxulus* in South Africa, appear to form a natural series. The apertural lamellæ and plicæ are arranged essentially as in the small forms of *Gastrocoptinæ*, but these genera differ from the latter by the generally larger and more solid shell of more numerous whorls, either cylindric with conic summit or somewhat fusiform or conic. As in other Gastrocoptinæ, the initial whorl is very minutely, irregularly granulose. The angular and parietal lamellæ are always separate throughout, and the axis is

tubular, though generally very slender, sometimes umbilicate, but usually closed at the base. In forms which have not degenerated in the teeth there is usually a subcolumellar lamella as well as a columellar. Many species have a tendency to form accessory folds on the peristome or in the throat.

The variety of shape, size and aperture is so great that a diagnosis of the supergeneric group is hardly practicable from the shells alone, and as yet we have not enough knowledge of the soft anatomy to be of use in this connection; yet the aberrant forms, which make a group diagnosis impossible, are united with the typical members by chains of species intermediate in character.

As fossils, very few forms which seem quite closely related to recent species of *Abida* have been found in the Oligocene, possibly the Eocene, of England, northern France and Germany, followed by a few Miocene species of Germany and Bohemia. See under *Abida*. It may be inferred that the group is a very ancient one, but its original habitat is problematic.

The following genera are included:

a^1. South African. *Fauxulus*, p. 234.

a^2. Palaearctic (Europe, northern Africa, western Asia).

b^1. Shell conic or globosely conic, umbilicate or closed, with a rather large columellar axis; aperture fully toothed in the typical positions, the plicæ short and marginal. *Odontocyclas*, p. 254.

b^2. Shell cylindric, turrite or fusiform.

c^1. Umbilicate, the internal axis large. *Sandahlia*.

c^2. Internal axis slender.

d^1. Fully toothed; palatal plicæ, or part of them, very long; radula with teeth of normal Pupillid type. *Abida*.

d^2. Palatal plicæ of moderate length, short or wanting.

e^1. Shell small (3 to 5 mm. long, 4½-6 whorls), rather slender, thin, pale or dull brown; teeth of radula of

normal Pupillid type, all of the laterals bicuspid. *Granopupa.*

e^2. Shell larger (5 to 10 mm. long, 6½-12 whorls), transparent brown or dark brown (but in the section *Solatopupa*, type *B. similis* Brug., opaque-whitish); teeth of the middle field of radula narrow and unicuspid. *Chondrina.*

Genus FAUXULUS Schaufuss.

Faula H. & A. Adams, Genera of Recent Mollusca, ii, p. 171, 1853, for *Pupa capensis, kurri, mühlfeldti, pottebergensis.* Not of Blanchard, 1850. — Martens, Die Heliceen, 1860, p. 298, type *Pupa capensis* Kurr. — *Fauxulus* Schaufuss, in Paetel, Molluscorum System et Catalogus, 1869, p. 15 (substitute for *Faula*, H. Adams).

The shell is rimate or perforate, cylindric with conic summit or acutely ovate-conic, of many (7½ to 12) narrow whorls, the last built forward. Aperture provided with at least 5 teeth in the typical positions — angular, parietal and columellar lamellæ, upper and lower palatal plicæ; often with secondary lamellæ and plicæ; the angular and parietal lamellæ are distinct and subparallel. Animal with both ocular and inferior tentacles.

Type *F. capensis.*

Distribution, South Africa, in Cape of Good Hope and Natal Provinces. The typical species lives on plants, but the others seem to be ground snails.

Fauxulus groups with the European genera *Abida, Chondrina* and *Odontocyclas.* The resemblance might be thought a case of convergence rather than affinity were it not that most other South African Pupillidæ belong to the European genera *Truncatellina, Lauria* and *Pupilla.* The correspondence of *Fauxulus* with *Abida* and its allies, both in form and apertural characters, is remarkably close. The presence of these Pupillidæ of Palæarctic type in a fauna for the greater part so utterly diverse in origin is one of the perplexing zoo-

geographic problems of Africa; the few other South African Pupillids having Oriental or American affinities.

The presence of two pairs of tentacles has been ascertained by Mr. Burnup in *F. ponsonbyanus* and *F. mcbeanianus*.

Part of the species of *Fauxulus* have been ably discussed and the difficult ones figured by Mr. H. C. Burnup, whose results have been utilized and often quoted herein. I have not seen *F. crawfordianus*, *F. fryanus*, *F. pereximius* or the typical form of *F. glanvillianus*, all of which appear to be known only by the original examples. Messrs. Burnup and Farquhar and Maj. Connolly have kindly assisted with specimens.

The species fall into three strongly characterized subgenera, defined in the following

Key to Subgenera and Species of Fauxulus.

a. Only the angular lamella emerges to the lip edge, the other teeth being placed distinctly deeper; spire rather thick; sinistral. Subgenus FAUXULUS, *s. s.*

b. Lip hardly expanded; 5 teeth, no basal plica; interior ochraceous. *F. capensis*, no. 1.

b^1. Lip strongly expanded; 8 or 9 teeth, suprapalatal, basal and subcolumellar being developed (section *Fauxulella*). *F. pamphorodon*, no. 2.

a^1. Angular lamella and upper palatal plica emerging to lip edge; spire slender above; peristome expanded throughout. Subgenus TOMIGERELLA.

b. Peristome not free above; no lamella between parietal and columellar; dextral. *F. crawfordianus*, no. 3.

b^1. Peristome free throughout; a small lamella in the angle between parietal wall and columella.

c. Dextral; rimate; 8 to 9½ whorls.

d. Length 8 to 9½ mm. *F. layardi*, no. 4.

d^1. Length 5½ to 7 mm. *F. l. stoaphora*, no. 4*a*.

c^1. Sinistral; deeply umbilicate; length 8, diam. 3 mm., 12 whorls. *F. fryanus*, no. 5.

a^2. All of the lamellæ and plicæ emerging to the lip edge; shell delicately rib-striate, not opaque; sinistral.

Subgenus ANISOLOMA.

b. Spire conic, conspicuously attenuate above; 9 teeth; 7 x 4 mm. *F. pereximius*, no. 6.

b^1. Spire conic or convexly conic, not attenuated; shells smaller.

c. Two lamellæ on the columella, there being no subcolumellar; 4 to 5 mm. long.

F. mcbeanianus, no. 7.

c^1. Three lamellæ on the columella.

d. Shell of stout, ovate-conic figure, diam. about 2 mm.

e. Imperforate; parietal callous spreading conspicuously upward.

f. Eight lamellæ and plicæ, no basal plica.

F. glanvilliana, no. 8.

f^1. Nine lamellæ and plicæ, a basal plica present.

F. g. novenarius, no. 8*a*.

f^2. 10-11 lamellæ and plicæ.

F. g. darglensis, no. 8*b*.

e^1. Perforate; parietal callous not spreading upward; 9 teeth.

F. g. tomlini, no. 8*c*.

d^1. Shell narrower, cylindric-conic; 9 teeth.

F. ponsonbyanus, no. 9.

1. FAUXULUS CAPENSIS (Küster). Pl. 39, figs. 1 to 9.

Shell sinistral, similar to the narrower examples of *P. dolium* in shape, ovate, cylindric, blunt-pointed, scarcely convex, thin-walled, scarcely narrowed below, finely striate, dull-shining, pale reddish-brown, the apex lighter. The 9 to 10 whorls are very low, oblique, nearly flat, only the last somewhat high; the suture simple, weakly impressed. Umbilicus oblique, rather large. Aperture small, obliquely rounded-triangular, 5-plicate; two rather large folds stand on the

parietal wall, one of them beginning at the outer edge, one on the columella, and two, unequal, on the palate, rather far within. The peristome is sharp-edged, not continuous, not thickened, arched outward somewhat, in front of the umbilicus. Aperture flesh-colored, the folds and peristome white. Alt. 3½, breadth 1½ lines (*Kuester*).

South Africa, Cape Province: in Zoetendals valley, Zwellendam district, on plants (Dr. Krauss, type loc.); Port Elizabeth (Crawford); Gordon's Bay (Connolly); St. Helena Bay; Saldanha Bay (Lightfoot); widely distributed on the Cape Peninsula, Buffelsfontein (Connolly). British Bechuanaland: Kuruman Moffatt (acc. to Layard).

Pupa capensis Kurr, KUESTER, Syst. Conch. Cab., *Pupa*, 1841, p. 10, pl. 1, f. 19, 20.—PFR., Symbolae ad Hist. Hel., ii, 1842, p. 53; Monogr. Hel. Viv., ii, 331. — *Pupa (Fauxulus) capensis* (Kurr), MELVILL & PONSONBY, Ann. Mag. N. H. (8), i, 1908, p. 83, with varr. *kurri* (Krauss) and *pottebergensis* (Krauss). — BURNUP, A. M. N. H. (8), vii, 1911, p. 411.— *Jaminea (Fauxulus) capensis* (Kurr), CONNOLLY, Ann. S. Afr. Mus., xi, pt. 3, p. 185.

This species is distributed in numerous forms through the southern part of Cape Colony. The record from Bechuanaland appears dubious. It is distinguished by having five lamellæ and plicæ in the ochreous aperture and generally an opaque-white or light-colored (bluish or fleshy) shell.

Fine spiral striæ, often very faint, may be seen on the later whorls. The angular and parietal lamellæ are parallel, the parietal stouter, higher, and far further within. The columellar lamella is horizontal in front, but its inner end curves upward into the columella. Both palatal plicæ are deeply placed, the lower one being longer.

As in some other Pupillid genera, the length varies far more than the diameter in the same locality, long and short individuals occurring together. This variation is common in *Cerion* and in fact in most cylindric land shells.

F. capensis reminds one of *Chondrina similis*, both having the opaque-whitish exterior and ochreous lining assumed by many land shells which live exposed to strong insolation.

An inspection of specimens from several localities, and of the published figures, gives one the impression that a number of local races might be recognized to advantage, the shape of the spire, the size and color offering differential features; yet Mr. Burnup, a careful student of African Pupillidæ, believes that the varietal names *kurrii* and *pottebergensis* "seem scarcely worth perpetuating, as all intermediate forms, as well as other forms with attributes of equal varietal value, exist." In any case, this is a question for naturalists on the ground, who should begin by securing topotypes of the old species collected by Dr. Krauss.

(*a*) A color-variety having the summit, a band below the suture, and the base ochre-colored has been collected at Buffelsfontein, Cape Point, where shells of uniform pale flesh-color and grayish white are also found. This appears to be typical *capensis*. Examples received from Mr. Connolly are drawn in figs. 1, 2 and 3. They measure, length 7.7, diam. 3.3 mm., 10 whorls; 7.1 x 3.5 mm., 9 whorls; 9 x 3.5 mm., 10⅓ whorls.

(*b*) Specimens collected by Mr. Jas. Crawford at Port Elizabeth (pl. 39, fig. 4) are all small, from length 6, diam. 2.7 mm., 9 whorls, to 5 x 2.6 mm., 8⅓ whorls; being therefore about the size of *pottebergensis*.

(*c*) Another form, the exact locality not known, measures, length 9.4, diam. 4.5 mm., 8¾ whorls (pl. 39, fig. 7). It has the large size and tapering spire of var. *ovularis* (fig. 5) and the probably identical form described as *fonticola* (fig. 9).

Figures 1-4, 7, are drawn to the same scale. Fig. 6 is copied from the original figure of *capensis*.

Translations of the original descriptions of forms subordinated to *F. capensis* follow.

Pupa ovularis Kurr, Kuester. Pl. 39, fig. 5. Sinistrally coiled. The shell shows similarity in conformation with *Bulimus ventricosus*, but has an altogether peculiar aperture. It is bluntly conic, somewhat convex, thin-walled, narrowed below, finely striate with matt luster, yellowish brown, the apex whitish; the 9 whorls are rather oblique, very low, almost flat, joined by a simple, thread-like suture, the last suddenly contracted, prolonged below, with a narrow umbil-

ical crevice. The aperture is higher than wide, relatively small, rounded. On the parietal wall there are two high, narrow folds, a third on the columella, and three smaller ones deep in the palate. Peristome is sharp-edged, ends separated, hardly thickened. Interior flesh-colored, folds and peristome white. Alt. 6½, breadth 2 lines. Zoetendals Valley, in the Zwellendam District of Cape Colony, on plants, collected by Dr. Krauss (*Kuester*).

Pupa ovularis Kurr, KUESTER, Syst. Conch. Cab., *Pupa*, p. 10, pl. 1, f. 16-18; not *P. ovularis* Lamarck. — *Pupa kurrii* Krauss, PFEIFFER, Symbolae, ii, 1842, p. 54; Monographia, ii, 331.

Pfeiffer re-named this form, being under the impression that the name was preoccupied by *Pupa ovularis* Lamarck. This was not the case, since the earlier *ovularis* was originally described as a *Bulimus*. Pfeiffer's description differs from Kuester's by attributing two teeth to the palatal wall, instead of three. Kuester's individual was probably abnormal or unusual by having an interpalatal plica developed.

Figs. 5, 7 and 9 agree in the tapering spire, and probably belong to one race, which will be called *F. c. ovularis*.

Pupa fonticola Deshayes. Pl. 39, fig. 9. The shell is oblong-conic, cylindroid, acute at the apex, sinistral, grayish, the base having a brown band; obsoletely and obliquely striate; spire acuminate, a little convex; whorls 11, narrow, at first flat, the rest very slightly convex, the last whorl very short, the base convex, rimate and perforate. Aperture small, semilunar, contracted laterally, brownish within, 5-toothed: three subequal teeth on the superior wall, two parallel in the left margin, one deeper, lamellar. Length 10, diam. 5½ mm. Cape of Good Hope, M. Verreaux, in brooks (*Desh.*).

Pupa fonticola DH., in Férussac, Hist. Nat. Moll. terr. et fluv., ii, 1851, p. 220, pl. 156, f. 26--28.

The very distinct and narrow brown band at the periphery of the last whorl is chiefly visible in the back view given by Deshayes. The spire tapers more acutely above than in specimens of *capensis* seen, being similar to *ovularis* in this respect. That M. Verreaux found it in the water was doubtless accidental.

Pupa pottebergensis Krauss, Kuester. Pl. 39, fig. 8. The shell is coiled sinistrally, cylindric-ovate, very blunt-pointed, somewhat narrowed below, very finely, obliquely striate, rather shining, pale horn-yellow, thin-walled, almost transparent; neck sharpened keel-like; umbilical opening very small, round. The 7 whorls are low, but little convex, rather oblique; the suture is simple, rather impressed. Aperture rounded, hanging down rather sack-like, contracted by several folds, of which two stand on the parietal wall, one on the columella and two deep in the palate. Of the folds of the parietal wall, one is larger and begins at the outer edge, the other being deep in the throat. Peristome disjoined, sharp-edged, hardly reflected. Alt. 2½, width 1⅓ lines. On plants on Potteberg Mountain, Zwellendam District, in the Cape Colony, discovered and sent by Dr. Krauss in Stuttgart (*Kuester*).

Pupa pottebergensis Krauss in litt., KUESTER, Conchyl. Cabinet, p. 17, pl. 2, f. 20-22.—PFEIFFER, Symbolae, ii, 1842, p. 54; Monogr., ii, 331. — BENSON, Ann. Mag. N. H. (2), iv, 1849, p. 127 (near the Round Battery in Simon's Bay, False Bay near the strand, and Hout Bay; in all these places it was found among plants and bushes growing on sandy dunes near the sea).

2. FAUXULUS PAMPHORODON (Benson). Pl. 39, figs. 10, 11, 12.

Shell sinistral, rimate-umbilicate, oblong ovate-conic, obliquely striate, under a lens seen to be decussate with obsolete spiral impressed lines, which are more conspicuous below; chestnut-colored. Spire cylindric-conic, the apex obtuse; suture impressed, submarginate. Whorls 10, a little convex, the last compressed below at the margin of the umbilicus near the aperture. Aperture vertical; peristome thin, expanded, orange, the margins converging; palatal wall provided with an upper denticle and three deep, entering, twisted plicæ; two parietal lamellæ, the inferior rather far in; one columellar lamella, deeply entering and somewhat doubled within; all of them white. Length 9, diam. 4 mm. (*Bens.*).

South Africa: Cape Peninsula at Simonstown, in the ravine behind the Admiralty House (E. Layard, type loc.); Kalk Bay, Slang Kop, Paul Berg and Cape Point (Connolly). Type in British Mus.

Pupa pamphorodon Bens., Ann. Mag. N. H. (3), xiii, July, 1864, p. 495. — Pfr., Monogr., vi, 1868, p. 320. — Sowerby, Conch. Icon., 1876, pl. 13, f. 120. — *Pupa (Fauxulus) pamphorodon* Bens., Melvill & Ponsonby, Ann. Mag. N. H. (8), i, Jan. 1908, p. 84, pl. 2, f. 24.—Burnup, Ann. M. N. H. (8), vii, 1911, p. 414.—*Jaminia (Fauxulus) pamphorodon* (Benson), Connolly, Ann. S. Afr. Mus., xi, pt. 3, 1912, p. 187.—? *Pupa secale* Drap., Sowerby, Conch. Icon., xx, 1876, pl. 4, f. 25.

It is easily distinguished from all forms of *F. capensis* by the darker color, more numerous teeth and well-expanded peristome.

The edge of the angular lamella is bent towards the suprapalatal denticle in the middle; parietal lamella arcuate. Columellar lamella enters horizontally; there is a small subcolumellar lamella below it, and often a blunt projection between them. Both upper and lower palatal plicæ enter deeply, and are more or less sinuous or bilobed, the crest being depressed in the middle. Basal plica similar but smaller, all entering deeply. The suprapalatal plica is tooth-like, defining a sinulus. There is a small interpalatal plica, and generally another, so deeply placed as to be not readily visible, between the basal plica and the columella.

Length 8.4, diam. above aperture 3.8 mm.; 9½ whorls.

Length 7.7, diam. above aperture 3.5 mm.; 10 whorls.

The specimens figured are from Simonstown, collected by Major Connolly.

This species differs so much from *capensis* that it may be placed in a section of the typical subgenus, to be called *Fauxulella.*

Subgenus Tomigerella Pfeiffer.

Tomigerella Pfr., Nomenclator Heliceorum Viventium, 1878, p. 347, for *Pupa soluta* Pfr.

Brown Fauxuli with the spire slender above, the lip well expanded throughout, usually free; only the angular lamella and upper palatal plica emerging to the lip edge. Type *F. layardi.*

The lamellæ and plicæ are more developed than in typical *Fauxulus*, from which *Tomigerella* differs also in shape, color and texture.

3. FAUXULUS CRAWFORDIANUS Melvill & Ponsonby. Pl. 41, figs. 1, 2.

Shell narrowly rimate, cylindric-fusiform, smooth, somewhat shining, thin, brown. Whorls 8-9, the apical mamillate, the rest impressed at the suture, nearly smooth, under a lens very obliquely longitudinally striate, the last shorter below the periphery. Aperture rotund; peristome white, glossy, reflected, continuous, six-plicate: two scimitar-shaped, parietal plicæ, one inferior acute, entering, two labial [palatal], entering deeply, the upper one oblique, the lower nearly straight; basal tooth subinternal, mammiform, columellar fold scimitar-shaped, deeply entering. Length 8, width 3.75 mm. (*M. & P.*).

South Africa: Mossel Bay, on the southern coast of the Cape Province (J. Crawford). Type in British Mus.

Fauxulus crawfordianus MELV. & PONS., Ann. Mag. N. H. (7), xii, Dec. 1903, p. 605, pl. 31, f. 6.—*Pupa crawfordiana* M. & P., Ann. Mag. (8), i, 1908, p. 71.—BURNUP, Ann. Mag. (8), vii, 1911, p. 402, pl. 10, f. 1, 2.

Mr. Burnup's figures of this species are copied. He writes: "Melvill and Ponsonby say of this species: 'Allied to *P. layardi* Bens'; but it is easily distinguishable by its stouter form, less ventricose whorls, shallower sutures, more regularly conical spire, less mammillated apex, rather smoother surface, less effuse peristome, and by the absence of the seventh, minute, plait to be seen, in *P. layardi*, at the junction of the parietal wall with the columella. The arrangement of the other peristomatal processes is practically identical in both species. The original figure is defective in form and deficient in detail, so I herewith offer new figures drawn from the co-type in Mr. Ponsonby's collection, kindly lent to me for the purpose. Mr. Ponsonby has compared my figures with the type in the British Museum, and finds that they correspond accurately, except that the callus in the type is not

chipped as in the co-type, so verifying that part of the original description recording the peristome as continuous. Of the co-type it would be more accurate to say that the ends of the peristome converge and are connected by a callus. Dimensions of co-type, alt. 6.96, lat. 3.38 mm."

4. FAUXULUS LAYARDI (Benson). Pl. 41, figs. 4, 5, 6.

Shell arcuately rimate, long-conic, obliquely striatulate, whitish [dead]; spire long-conic, at the apex rather obtuse; suture impressed. Whorls 9, the upper ones somewhat convex, at the apex convex, the rest somewhat flat, last whorl ascending in front, narrowed behind the aperture, somewhat scrobiculate, the base compressed-crested. Aperture triangularly obovate, vertical, shortly free, six-plicate; peristome expanded throughout, the margins thin, acute, right margin with three plicæ, columella with one descending fold. Parietal wall with an angular and a second remote one, all deeply entering. Parietal margin having a remote denticle between the inferior parietal fold and the columella. Length 8 mm. (*Benson*).

South Africa: Cape Point (E. L. Layard, type loc.); Hermanus (Lightfoot). Type in University Mus. of Zoology, Cambridge.

Pupa layardi BENS., Ann. Mag. N. H. (2), xviii, 1856, p. 435; (3), xiii, p. 496, with var. *minor*.—PFEIFFER, Monogr., iv, p. 674; vi, 318.—SOWERBY, Conch. Icon., xx, 1876, pl. 15, f. 141.—MELVILL & PONSONBY, Ann. Mag. N. H. (8), i, p. 78, pl. 2, f. 13.—BURNUP, (8), vii, 1911, p. 407, pl. 10, f. 3, 4.—*Jaminia layardi* (Benson), CONNOLLY, Ann. S. Afr. Mus., xi, pt. 3, 1912, p. 182.

Mr. Benson first described this species from dead and broken shells, subsequently giving additional details (which I have incorporated into his description) from fresh examples. Figs. 4-6 are from Cape Point specimens supplied by Major Connolly. The shell is semitransparent-brown (auburn of Ridgway) when fresh. The trumpet-like mouth and long lamellæ, which almost fill the aperture, are its more noticeable characters. The lower palatal plica is much larger than the

upper, which descends inwardly, both being visible as whitish lines externally (fig. 5). Topotypes measure:

Length 9.4, diam. penult whorl 3 mm.; 9⅓ whorls.

Length 8, diam. penult whorl 3 mm.; 8½ whorls.

Mr. Burnup's illustrations of specimens from Hermanus, Caledon Division, east of False Bay, show the "neck" is shorter than in shells seen from the Peninsula. Mr. Burnup writes:

"Since the peristome is not at all thickened at the edge, but, on the contrary, is remarkably thin and brittle, the lips are invariably more or less chipped. One of the most conspicuous differences between the present species and *P. crawfordiana* M. & P. is the absence from the latter of the trumpet-like extension of the peristome observable in the former."

The dimensions of two specimens figured by him are as follows:

Height 7.87, width 3.26 mm.

Height 7.87, width 3.67 mm.

"The shells of this species may be either white or horn color, and the position of the seventh peristomatal process, the denticle between the inferior parietal and the columellar plait is very variable; it is sometimes seen on the parietal wall, sometimes on the columella, and sometimes in the angle between" (*Burnup*).

Pupa soluta Pfr. — Shell deeply rimate, long-conic, thin, very lightly striate, pellucid, brown-corneous. Spire ovate-conic, the vertex rather acute. Whorls 9, a little convex, the last free in front, produced horizontally, compressed at the base. Aperture reaching beyond the axis at base, truncate-oval, nearly closed by 6 long lamellæ: one parietal and the upper palatal stronger and reaching the margin, the second palatal, one basal and two columellar lamellæ more deeply placed; peristome continuous, thin, shortly expanded, the upper margin free and a little straightened. Length 8, diam. of penult. whorl 3 mm.; aperture 2¾ mm. long, 2 wide (*Pfr.*).

Habitat unknown (Mus. Cuming and Pfeiffer coll. no. 110).

Pupa soluta Pfr., Proc. Zool. Soc. Lond., 1863, p. 525; Monogr. Hel. Viv., vi, p. 315.

"A very singular species, calling to mind *Tomigerus*" (*Pfr.*).

Until the type of this species is re-examined it may well be considered a synonym of *F. layardi.* Pfeiffer evidently thought the parietal lamella a columellar, his *parietal* being the angular lamella. He did not mention the minute supra-columellar which is present in *F. layardi.* Otherwise the description applies well to that species.

F. layardi stoaphora ('Bens.' Burnup). Pl. 41, figs. 7, 8.

The shells "agree in all essentials with *F. layardi* Bens., except in their smaller size and darker color.

"Height 6.88, width 3.07 mm.

"Height 5.67, width 2.75 mm." (*Burnup*).

Length 6.4, diam. above aperture 2.4 mm.; 8⅓ whorls.

Length 6, diam. above aperture 2.8 mm.; 7½ whorls.

Bredasdorp, Cape Province (Layard).

[*Pupa layardi*] var. *minor* Benson, Ann. Mag. N. H. (3), xiii, 1864, p. 496.—*Pupa layardi* var. *minor* Bens.? [*P. stoaphora* Bens.], Burnup, Ann. Mag. N. H. (8), vii, 1911, p. 408, pl. 10, f. 5, 6.

Benson appears to have distributed this form under the name *Pupa stoaphora* to various collections, such as the British Museum, John Ponsonby and A. Morelet, now in A. N. S. P.; subsequently describing it as *Pupa layardi* var. *minor*, his own examples, now in Cambridge Zoological Museum, being under this name. As *minor* had been used several times for varieties of *Pupa* previous to Benson's description, we substitute *stoaphora*, which was first defined by Mr. Burnup from "two shells in the collection of Mr. Ponsonby, given to him by Mr. Benson as representing his species *stoaphora.*"

The last two measurements given above are from specimens labeled by Benson, one received through Morelet, the other through Sowerby and Fulton. The latter is wider than those figured, and the last whorl ascends in front, the aperture being tilted upward a little.

Benson defined var. *minor* as follows: "Chestnut-corneous, translucent; aperture orange-whitish; whorls 8. Length 5½–7, width 2–3 mill. Inhabits Bredasdorp."

One of Mr. Burnup's figures is copied in fig. 8; fig. 7 being from a shell in A. N. S. coll., from Benson through Morelet.

5. FAUXULUS FRYANUS (Benson).

The shell is sinistral, very deeply umbilicate, long ovate-conic, obliquely plicate-striate, the striæ very closely decussated spirally; lilac-white, brownish towards the apex, the last whorl ornamented with a brownish band below the periphery. Spire subcylindric-conic, suture impressed, the apex rather obtuse. Twelve narrow, convex whorls, the last one ascending in front, compressed near the aperture, marked longitudinally with two impressed lines; foveate above, behind the aperture, with an obtuse crest on each side, the base compressed-carinate around the umbilicus. Aperture vertical, free, triangular-obovate. Peristome thin, expanded throughout, a little reflected, the palatal margin deeply sinuated above, having two deeply entering folds, the lower one deeper; basal margin with one and columella two, deeply placed. On the parietal wall two long entering lamellæ, the inferior one deep, and a tooth towards the columellar angle. Length 8, diam. 4, above aperture 3 mm. (*Bens.*).

South Africa: Bredasdorp, Cape Province (J. Fry). Type in British Museum.

Pupa fryana BENS., Ann. and Mag. N. H. (3), xiii, June, 1864, p. 495.—PFEIFFER, Monogr., vi, p. 319.—*Jaminia (Fauxulus) fryana* (Benson) CONNOLLY, Ann. S. Afr. Mus., xi, pt. 3, 1912, p. 186 (at the roots of grasses, among stones, Layard).

F. fryana does not seem to have been taken by recent Cape naturalists. It has not been figured.

"This sinistrose species is very peculiar, with reference to its deep umbilicus running up to the summit, as in the unique Chinese *P. regalis* B., its carinate base, and handsome sculpture. In some respects it exhibits a relation to the imperforate *P. layardi*, especially with reference to the imperfect tube at the top of the aperture, formed by the convergent palatal and parietal plaits. It was discovered at Bredasdorp, at the southern shore of Swellendam, by Mr. John Fry. Mr. Layard reports that the animal is jet-black, very short and thin, the shell being carried on one side, or tilted up in a line with the animal" (*Benson*).

Subgenus ANISOLOMA Ancey.

Anisoloma ANCEY, Journ. de Conchyl., xlix, 1901, p. 141, for *P. ponsonbyana, P. glanvilleana* and *P. pereximia.*

Fauxuli in which all, or nearly all, of the lamellæ and plicæ emerge to the lip-edge; suprapalatal plica present; periphery defined by a change in sculpture. Type *F. ponsonbyana.*

The teeth are very fully developed in this group, which somewhat resembles the European *Odontocyclas* by its emerging folds. The sinulus is limited by a suprapalatal plica, while in *Tomigerella* the upper palatal forms its limit. Species and local races will probably prove to be somewhat numerous. Both albino and colored shells occur in most lots. They appear to be ground snails.

6. FAUXULUS PEREXIMIUS (Melvill & Ponsonby). Pl. 40, fig. 3.

Shell sinistral, pyramidate, subrimate, much attenuated towards the apex; whorls 9, of which two apical are tumid, the rest channellel at the sutures, tile-like, all roughly lirate, the liræ curved; last whorl shortened. Aperture rhomboidal; peristome white, wrinkled, thickened, furnished with 9 folds or teeth: two parietal folds, similar and deeply entering; two lip teeth, of which the lower is plicate, larger; two basal folds, very long, entering; two columellar folds, and at the base one small tooth. Length 7, width 4 mm. (*M. & P.*).

South Africa: Buffalo River, Cape Province (M. & P.).

Pupa (Faula) pereximia MELV. & PONS., Ann. Mag. N. H. (6), xix, June 1897, p. 638, pl. 17, f. 3.—*Pupa (Fauxulus) pereximia* M. & P., Ann. Mag. (8), i, p. 85, pl. 2, f. 25.

So far as I know, only the type lot has been found. The figure is a copy of that of Melvill and Ponsonby. It is distinct by the large size and the tapering, attenuated spire.

7. FAUXULUS MCBEANIANUS Melvill & Ponsonby. Pl. 40, figs. 4, 5.

The shell is perforate and rimate, ovate-conic, whitish or light brown, finely and regularly obliquely striate, the striæ interrupted at the periphery, weaker on the base, which is partly smooth in front. Aperture somewhat triangular.

Peristome narrowly expanded and a little reflected, the ends joined by a thin parietal callous with convex upper edge; outer margin strongly bent in above the middle, columellar margin sloping, nearly straight. Angular lamella thin and almost or quite as long as the parietal, curving into the outer lip above. Parietal lamella strong and straight. Columellar lamella horizontally entering, an oblique supracolumellar lamella converging towards it. In the outer lip there is a nodular suprapalatal which is typically weakly twinned but sometimes simple; an entering but short upper palatal, and a long, very slightly bent lower palatal plica; basal plica smaller and straight.

Length 4.1, diam. above aperture 2.3 mm.; 7½ whorls (fig. 4).

Length 5, diam. 2.25 mm. (M. & P., spec. max.).

South Africa: Karkloop Bush (McBean, type loc.); Majuba (Connolly); Dargle; Nottingham Road; Inhluzani Mt. (Burnup), all in Natal. Type in British Museum.

Fauxulus (Anisoloma) McBeanianus Melv. & Pons., Ann. Mag. N. H. (7), viii, Oct. 1901, p. 319, pl. 2, f. 9 (bad).—*Pupa (Fauxulus) Mcbeaniana* (M. & P.), Burnup, Ann. Mag. (8), vii, 1911, p. 414, pl. 10, f. 8.—*Jaminia (Fauxulus) mcbeaniana* Melv. & Pons., Connolly, Ann. S. Afr. Mus., xi, p. 187.

The figure is from a topotype sent by Mr. Burnup.

"This striking shell, larger than the preceding species and its varieties, may be horn-colored, greyish-brown, or milk-white. Normally this species has nine peristomatal processes, viz. two parietal, two columellar, one basal, and four labral, of which last named the lowest is large, the central small, and above this, in the sinus of the labrum, are two, very small and close together. In the type, which is not available to me for examination, these two small plaits may be merged into one broad plait, as in the case of a shell from Inhluzani Mountain, in my collection; for the authors do not refer to a pair, nor does the original figure show it. One shell in my collection, also from Inhluzani, bears an additional plait at the base of the columella; but as it is only one example in many,

and is otherwise normal, it must only be looked upon as a sport'' (*Burnup*).

8. Fauxulus glanvillianus (Ancey).

Shell ovate-subconoid, imperforate but with a long rimation, thin, somewhat shining, whitish, pellucid, sinistral. Spire conoid-subventricose, with convex outline, smooth and a little obtuse at the summit. Whorls 8¼ to 8½, regularly and gradually, slowly increasing, but slightly convex, separated by a simple, not deep, suture, obliquely, arcuately and regularly striate, the last whorl more convex, tapering, compressed-carinate in front, around the place of the umbilicus; striæ suddenly breaking off in the middle of the last whorl, yet visible below, the median space simulating a narrow angle. Aperture upright, irregular, strongly ringent, ascending above, subrhombic, whitish, obstructed and nearly closed by lamellæ as follows: one strong, entering parietal; 4 palatals, the upper [= angular lamella] large, at the superior angle, oblique, and outside prominently separated from the rest by a lobe which has the appearance of being tubular within; second and third subequal, the lower strongly twisted; 3 columellar lamellæ, strong and subequally spaced. Peristome thickened, subexpanded, the lamellæ reaching to the margin, the outer margin lobed above, then nearly straight, and slightly angled near the base, then running straight, basal margin strongly angular, columellar margin long, flatly straight, the margins continuous by an appressed parietal callous. Length 4, diam. 2, alt. of aperture 1½ mm. (*Ancey*).

South Africa: East London (Miss Glanville).

Pupa glanvilliana Ancey, Le Naturaliste, 1888, p. 200.—*Pupa (Fauxulus) glanvilleana* (Ancey), Melvill & Ponsonby, Ann. Mag. N. H. (8), i, 1908, p. 83.—Burnup, Ann. Mag. (8), vii, 1911, p. 411.

Mr. Ancey's upper palatal lamella is the *angular lamella*, as Mr. Burnup pointed out. It is separated from the palatal plicæ by the sinulus or ''lobe.'' His second and third, described as subequal, are the *suprapalatal* and *upper palatal plicæ*, and his lower is the *lower palatal plica*. Nothing is

said of any basal plica; if present it was overlooked, only 8 lamellæ and plicæ being mentioned. It appears likely that a basal plica is present, but until the type can be found, or full collections made at the type locality, the question remains undecided.

F. g. novenarius n. subsp. Pl. 40, figs. 1, 2.

This form resembles *F. glanvilliana* and *F. g. darglensis* in having the parietal callous spread far upward on the face of the penult whorl. It is imperforate. The angular lamella is heavy and arcuate, concave towards the left. The inner end of the parietal lamella curves towards the columella. The columellar lamella has its edge bent conspicuously downwards. The supra- and subcolumellar lamellæ are well developed and very long. The suprapalatal plica, defining the sinulus, is pliciform but shorter than the upper palatal. Lower palatal plica very long, its edge flattened and bent upward, the inner end descending a little. Basal plica is interrupted or weakens inwardly. Color nearly white or brown, slightly transparent.

Length 3.9, diam. 2.1 mm.; 8 whorls (fig. 1).

Length 4.1, diam. 2 mm.; 8¼ whorls.

South Africa: Grahamstown. Type no. 114989 A. N. S. P., received from Sowerby & Fulton.

F. g. darglensis has an additional basal plica, also an incipient fold above the suprapalatal, in all 10 or 11 plicæ and lamellæ; the present form has 9 in all. Whether *novenarius* is identical with *F. glanvilliana* depends upon whether that proves to have a basal plica.

F. g. darglensis (Burnup). Pl. 40, fig. 6.

Shell small, conic-oval, rimate and very narrowly perforate, thin, shining, greyish horn-colored, translucent, sinistral. Spire ovately conic; apex obtuse and mammillated. Whorls 7½, slightly convex, gradually increasing, with suture distinct but not deep, obliquely sculptured with close, sharply-cut, arched oblique striæ, except the first 1½, which are smooth, the last more convex, rounded below, much constricted towards the peristome and impressed towards the rima and small perforation, the long inrunning peristomatal pro-

cesses and spaces between being represented on the outside by alternate grooves and ridges. Aperture upright, irregularly ovate, nearly closed with the following inrunning white plaits:—parietal 2, the first arising as a narrow thread high on the body-whorl, becoming broader and contorted as it descends, always receding inwards, to below the center of the aperture, whence it is bent sharply back, embracing the parietal wall, till it is lost sight of in the interior of the shell; the second, also arising high on the body-whorl, is expanded on the left till it meets the peristome, with which it combines till the lobe of the labrum is reached, whence it doubles back in two foliaceous folds and descends as a simple plait, receding inwards and following a line parallel with the first till it too is lost sight of in the interior of the shell; labral 3, of which the upper two are small, though deeply penetrating the aperture, and rather close together; the third, though equally narrow, is very long and sinuous, and as, in its progress towards the interior, it embraces the expanded outer lip, it is lost to sight till the far end reappears in the gullet; columellar 3, of which the upper two arise, thread-like, on the edge of the labium, becoming stouter as they curve inwards, the upper one entering at the junction of the parietal wall with the columella, and the lower about the middle of the columella, after taking a wide sweep towards the center of the aperture; the lowest columellar plait is smaller, but long and penetrating: lastly, there are two plaits on the base of the peristome similar to the lowest columellar plait. Peristome widely expanded, but little thickened except by the plaits which arise close to the margin, paler than the rest of the shell, becoming white at the edges, where its outline is slightly peaked at the sources of the plaits; the ends converge and are connected by a stout glossy callus reaching high on the body-whorl. The labrum is strongly lobed above the middle and bayed immediately below; on the lower part of this lobe the peristome is slightly thickened, almost to the extent of forming an eleventh plait, between which and the foliated extension of the lower parietal plait is formed a partly covered channel to the interior (*Burnup*).

Height 3.77, width 2.13 mm.

South Africa: Dargle; Inhluzani Mt.; Karkloof; Mid Illovo; Game Pass, near Giant's Castle, Drakensberg; Ntimbankulu, all in Natal (Burnup).

[*Pupa glanvilliana*] var. *darglensis* BURNUP, Ann. Mag. N. H. (8), vii, 1911, p. 412. — *Pupa (Fauxulus) glanvilleana* (Ancey), MELVILL & PONSONBY, Ann. Mag. (8), i, 1909, pl. 2, f. 23.—*Jaminia (Fauxulus) glanvilleana* var. *darglensis* Burnup, CONNOLLY, Ann. S. Afr. Mus., xi, pt. 3, p. 186.

"The color of the shell in life is often whitish gray."

This shell "does not by any means agree closely with Ancey's description, being shorter and wider than the typical *glanvilleana*, and possessing two plaits on the base of the peristome not mentioned in Ancey's description, besides showing other discrepancies" (*Burnup*).

The figure is a copy of Melvill & Ponsonby's lithograph from Burnup's drawing.

F. g. tomlini (Burnup). Pl. 40, fig. 8.

"Shell like var. *darglensis*, but larger and more conical, with peristome less effusively expanded, callus not extending so high on the body-whorl, and aperture not so much closed by plaits. The lobe and sinus of the labrum are less developed and the thickening of the peristome on the lower part of the lobe 'almost forming an eleventh plait' is entirely absent, its place being taken by the first labial plait. The lower parietal plait is shorter and its foliated extension to the peristome much less effuse, leaving the sutural canal more open. In place of the two in-running plaits on the base of the peristome there is only one, about equidistant between the lowest labral and lowest columellar plait. The color of the varietal type is almost white, that of the co-type pale brown. Height (type of var.) 4, width 2.11 mm. Height of Radford's specimen 4.17, width 2.27 mm." (*Burnup*).

South Africa: Albany (Miss Glanville, type loc.); East London (Radford); Gamtoos (Reeve); The Gorge, Somerset East (Burnup); all in the Cape Province.

The var. *tomlini* should be easily distinguished from typical

F. glanvilliana by the angular lamella "being less strongly developed, and by the presence of a narrow perforation and a basal plait, absent from the type" (*Burnup*).

Fig. 8 represents a brown specimen from The Gorge, Somerset East. The angular and parietal lamellæ are almost straight in these examples, the subcolumellar quite weak. The suprapalatal and upper palatal plicæ are contiguous, short, the latter entering about twice as far as the former. Lower palatal plica is long and curves downward very slightly towards the inner end. The basal plica is nearly as long, but smaller and straight. Length 4.2, diam. above aperture 1.95 mm.; 8½ whorls.

9. FAUXULUS PONSONBYANUS (Morelet). Pl. 40, figs. 7, 9, 10.

Shell minute, sinistral, imperforate, ovate-conoid, rather thin, a little shining, tawny, silky, closely and straightly rib-striate. Spire tapering gradually in an obtuse cone. Whorls 8, planulate, joined by an impressed suture, the last constricted at the base, gibbous, transversely sulcate, depressed around the umbilical area. Aperture small, contracted, ringent, obstructed by two parallel, arcuate, parietal folds, which reach far up, and a series of 6-7 marginal denticles; peristome a little thickened, not dilated or reflected. Length 3, diam. 1⅓ mm. (*Morelet*).

South Africa, Cape of Good Hope: Port Elizabeth (type loc., Crawford); Somerset East (Miss Bowker); Grahamstown; Bathurst, Kowie (Farquhar); Alexandria District (Crawford); Pirie (Godfrey). Natal: Hilton Road; Zwaart Kop near Maritzburg (Burnup).

Pupa (Faula) ponsonbyana MORELET, Journ. de Conchyl., xxxvii, 1889, p. 9, pl. 1, f. 5 (bad).—*Pupa (Anisoloma) ponsonbyana* Morel., ANCEY, Journ. de Conch., xlix, 1901, p. 140. —*Pupa (Fauxulus) ponsonbyana* Morel., MELVILL & PONSONBY, Ann. Mag. (8), i, p. 85.—BURNUP, Ann. Mag. (8), vii, p. 415, pl. 10, f. 9-12.—*Jaminia (Fauxulus) ponsonbyana* (Morelet), CONNOLLY, Ann. S. Afr. Mus., xi, pt. 3, p. 187.

This is the smallest species now known. The shape is cylindric-conic. The delicate striæ bear short, very delicate hairs

at the peripheral interruption and in the suture, as noticed by Ancey, but they are very easily removed by washing or handling after becoming dry. The angular lamella is enlarged before passing into the outer lip, and often bears a little point projecting into the sinulus. The parietal lamella emerges nearly to the edge of the parietal film; both are straight within. Columellar lamella enters horizontally, but its edge is a little bent downward. The supracolumellar and infracolumellar converge inwards towards the columellar. A suprapalatal denticle defines the sinulus, the short upper palatal plica being near it. The lower palatal is at least double the length of the upper, nearly straight. Basal plica smaller but long. The lamellæ and plicæ project as little points on the slightly expanded peristome. All of them show outside through the shell, and the palatal plicæ form little external ridges. Specimens from Grahamstown measure:

Length 3, diam. 1.4 mm.; 7¾ whorls.

Length 2.9, diam. 1.45 mm.

Mr. Burnup, who has given a good account of this species, with excellent figures, found the length to vary from 2.74 to 3.59 mm. He notes that the two specimens found in Natal are remarkably high and narrow, one from Hilton Road measuring 3.53 mm. high, 1.62 mm. wide.

The extremes of size in another lot from Grahamstown, kindly sent by Mr. J. Farquhar, are:

Length 3.45, diam. 1.65 mm.; 8 whorls.

Length 2.75, diam. 1.3 mm.; 7⅓ whorls.

The larger shells are a little more swollen in the middle than the smaller, which are more cylindric, like fig. 7. Most of them retain hairs along the suture.

Genus ODONTOCYCLAS Schlueter.

Odontocyclas Schlueter, Kurzgefasstes Syst. Verzeich. meiner Conchyliensammlung, 1838, p. 10, for *kokeilii.—Scopelophila* Albers, Die Heliceen, 1850, p. 206; Edit. 1860, p. 296, type *Pupa kokeilii.*

The shell is conic with very convex base, of 7-8 *convex* whorls, the last built forward to the ventral convexity and

ascending in front. Internal axis rather large, either forming an open umbilicus or closed at the base, which is rimate. Aperture vertical, rotund, having angular, parietal and columellar lamellæ, upper and lower palatal and basal plicæ, and usually some smaller secondary lamellæ and plicæ. Angular and parietal lamellæ parallel, the former not curving into the lip; all teeth marginal or nearly so, and none entering deeply, those of the lip standing on a callous rim.

According to Pfeiffer, Schmidt says that the superior tentacles of *rossmaessleri* appear as if somewhat broken and thickened near the apices.

Type *O. kokeilii* (Rm.).

Distribution, eastern outliers of the Alps, in Carinthia, Carniola and neighboring regions.

Illustrated on plate 41. *Odontocyclas* is a peculiar genus having some resemblance to *Abida, Sandahlia, Anisoloma* and *Paraboysidia;* distinguished from all by its apertural folds, which are marginal; not entering deeply. The lamellæ also do not enter far. The apical whorls are very minutely granulose, as in related genera. By the somewhat large columellar axis *Odontocyclas* resembles *Sandahlia.* It is an isolated group, not known fossil.

Odontocyclas appears to have the habits of *Abida,* also *Hypselostoma* and *Boysidia,* crawling on rocks (probably limestone). It is like *Sandahlia* and *Rupestrella,* and the much more distantly related *Gastrocopta* and *Hypselostoma* in having the shell coated with slime and dirt.

There are two species, distinguished as follows:

a. Shell straightly pyramidal, umbilicate, delicately striate; with 6 larger teeth.

b. Small denticles between the plicæ of the lip. *O. kokeilii,* no. 1.

b[1]. No denticles between the lip plicæ. *O. k. mitescens,* no. 1*a.*

a[1]. Shell broadly ovate, imperforate or nearly so, rib-striate; 7 larger teeth. *O. rossmaessleri,* no. 2.

1. ODONTOCYCLAS KOKEILII (Rossmaessler). Pl. 41, figs. 9, 10, 11.

The shell is narrowly but *deeply umbilicate*, rimate, straightly pyramidal, of a cinnamon-buff or paler tint, somewhat translucent, closely and delicately striate. Whorls all convex, the last inflated basally, contracted behind the lip and ascending forward. The aperture is rotund, obstructed by 6 principal teeth, placed at about equal intervals (angular, parietal and columellar lamellæ, upper and lower palatal and basal plicæ), all but the parietal, marginal; upper palatal plica tubercular, the lower larger, pliciform. Small secondary plicæ stand between the primaries on the lip, and small lamellæ on the parietal wall (those at the angles more emphatic), and above the columellar lamella. The lip is well expanded and thickened within.

Length 4, diam. above aperture 2.35 mm.; 7½ whorls.

"Animal entirely blue-gray, very similar to that of *P. pagodula;* carries the shell upright" (*Clessin*).

Carinthia, Carniola, Croatia and Dalmatia; eastern border of Venetia; type loc. on the Loibl, on the northern confines of Carniola. Lives in moist, shady places, on walls and rocks, and is generally covered with dirt.

Pupa kokeilii ROSSMAESSLER, Iconographie, etc., i, pt. 5, 1837, p. 18, pl. 23, f. 335 (on the Loibl, and near Neumarktel, Rossmaessler and Kokeil; on the Krimmberg and Grossgallenberg, near Laibach, Schmidt; all in Carniola).—KUESTER, Conchyl. Cab., p. 16, pl. 2, f. 16-19.—SCHMIDT, Syst. Verz., p. 14.—PFEIFFER, Monogr. Hel. Viv., ii, p. 353; vi, 323.—WESTERLUND, Fauna, iii, 1887, p. 120, with form *mitescens.* — *Pupa kokeilii* Rossm., KUESTER, Ber. Nat. Ges. Bamberg, ix, 1870, p. 100 (Almissa and Obrovazzo). — *O*[*dontocyclas*] *kockeilii* Rossm., POLLONERA, Bull. Soc. Malac. Ital., xii, 1886, p. 222 (Malborghetto in the Valle del Falla, Vacino del Tagliamento). — *Odontocyclas kokeili* Rossm., CLESSIN, Molluskenfauna Oesterreich-Ungarns und der Schweiz, 1887, p. 239, f. 142 (Grossgallenberg bei Eisnern, Glince, St. Katharina, St. Georg, Zwischenwassern bei St. Leonhard, etc.; Friaul, Kirchheimer Bergland and in the Bacatal).—GALLENSTEIN, Jahrb.

naturhist. Landes-Mus. Kärnten, Jahrg. 47, 1900, p. 102 (distribution).—Kormos, Nachrbl. D. Mal. Ges. 39, Oct. 1907, p. 192 (Croatia, at Lukovdol; Plitvica; Kukuljanovo; Senj, on the ruins of Nehaj, on the coast).—*Helix moricandi* Férussac, Prodr., p. 60, no. 480, no description.

Rossmaessler found this species when on a shell hunt in company with his friend Kokeil, of Klagenfurt, in whose honor it is named. The shells were covered with soil, resembling little balls of earth, and were found on rocks and old walls. The species had previously been found at Idria by S. Moricand, in 1812, and named, but not described, by Férussac.

Form *mitescens* Westerlund. Pl. 41, fig. 11. The smaller plicæ on the peristome are wanting and only the six larger ones are developed (*West.*).

2. Odontocyclas rossmaessleri ('Schmidt' Rossm.). Pl. 41, figs. 12, 13.

Shell with wholly closed, circumflex-shaped umbilical crevice, conic, with somewhat convex sides, from a globular base, clear corneous, translucent, thin, unevenly rib-striate, slightly glossy. Whorls 7, convex, united by a rather deep suture, the last whorl strongly inflated, yet somewhat contracted beneath, the neck constricted behind the peristome. Aperture narrowed by many larger and smaller teeth. Peristome with ends separated, reflected, with seven rather large teeth, of which two are on the parietal wall and five on the lip margins (*Rossm.*).

Length 4.5, diam. above aperture 3 mm.

Carinthia, Carniola, eastern Venetia. Type loc., Monte Manos, near Prewald (Schmidt).

Pupa rossmaessleri Schmidt MS., Rossmaessler, Iconographie der Land- und Süsswasser-Mollusken, etc., ii, parts 7 and 8, p. 39; pt. 10, p. 27, pl. 49, f. 644 (1838).—Kuester, Conch. Cab., *Pupa*, p. 16, pl. 2, f. 13-15.—Pfr., Monogr., ii, p. 353.—Pollonera, Bull. Soc. Malac. Ital., xii, 1886, p. 222. —*Odontocyclas rossmaessleri* Kok., Clessin, Molluskenfauna Oesterreich-Ungarns u. Schweiz, p. 240, f. 143 (only in Carinthia, Mt. Nanos, Lueg, and in the Birnbaumer Walde, and in

Friaul from the Birnbaumer Walde over the Trnovaner and Banjsicaer plateaux to the Isonzo valley and beyond into the Venetian Friaul).

O. rossmaessleri is very distinct from *O. kokeilii* by the obese shape, the umbilical crevice shaped like a reversed "s," the spaced riblets, and the presence of a well-developed supra-palatal tubercle bounding the sinulus. The columellar axis is rather large within, but contracts in the last whorl, closing the umbilicus as described by Rossmaessler, or sometimes leaving a narrow umbilical opening.

O. rossmaessleri has been reported from northeastern Italy by the Marchesa Paulucci (*Materiaux*, p. 11) without definite locality; also from the Province of Venetia by De Betta (*Malacologia Veneta*—not seen by H. P.). Pollonera notes that this species is not rare in some parts of Friuli (Friaul), but it is surely very rare in the Natisone Valley, where he could find but a single example, of a form much more lengthened and with the aperture more contracted by the teeth, but not the typical form figured by Rossmaessler.

Genus SANDAHLIA Westerlund.

Sandahlia West., Fauna Paläarct. Reg. Binnenconchylien, iii, 1887, pp. 78, 92.

The shell is cylindric, of many closely coiled whorls; umbilicate, the umbilicus enlarging within; *the hollow columellar axis large*, widest in the upper part. Aperture having very long lamellæ and plicæ arranged as in *Abida*. Type *Pupa cylindrica* Mich.

Distribution: eastern Pyrenees, in the Pyrénées-Orientales, France, and Prov. Gerona, Spain. Living under stones and dead leaves.

Figured on plate 46. The conchological features of *Sandahlia*, particularly the large columellar axis (as shown in pl. 46, fig. 3), make its recognition as a genus desirable, even though the apertural characters are unmistakably those of *Abida*. Though the outward form is that of *Orcula*, I cannot trace the relationship some authors have claimed. In my view the two genera belong to different subfamilies.

1. SANDAHLIA CYLINDRICA (Michaud). Pl. 46, figs. 1, 2, 3.

The shell is *umbilicate* (*the cavity enlarging inward*), cylindric with short terminal cone and obtuse apex; wood brown; closely, finely and obliquely rib-striate. The whorls are very narrow, slowly increasing, convex, the last half of the last whorl straightened, enlarging and becoming white towards the aperture, flattened laterally, somewhat carinate beneath, marked with 4 white spiral lines; the suture abruptly ascending near the aperture. The aperture is truncate-oval, vertical, obstructed by numerous teeth: angular lamella duplicated, extending inward past the dorsal side, enlarged at the inner end; its twin branch is shorter, though long. Parietal lamella strong, penetrating past the dorsal line. Columellar lamella subhorizontal, long, ascending at the inner end; subcolumellar more oblique. Upper and lower palatal plicæ strong, emerging, extending inward to a lateral position on the left side where they are enlarged, and accompanied by a suprapalatal and a small sutural fold. Basal fold interrupted, but having an inward continuation like the others. There are also some short accessory folds and lamellæ on the basal, columellar and parietal margins. Peristome is somewhat expanded and well thickened.

Length 7.7, diam. above aperture 2.8 mm.; 11½ whorls.

Length 7, diam. above aperture 2.9 mm.; 10½ whorls.

Spain: Bascara, a village south of Figueras, prov. Gerona, under stones (Michaud). France: Villefranche, Arles, Prats-de-Mollo and la Preste (Pyrénées-Orientales).

Pupa cylindrica MICHAUD, Bull. d'Hist. Nat. de la Soc. Linn. de Bordeaux, iii, 1829, p. 268, figs. 17, 18.—ROSSMAESSLER, Iconogr., pt. 10, p. 27, pl. 49, f. 643.—KUESTER, Conchyl. Cab., p. 98, pl. 13, f. 12-15.—PFR., Monogr., ii, 337; iii, 545; iv, 671; vi, 312.—MOQUIN-TANDON, Moll. Fr., p. 381, pl. 27, f. 20-23; with var. *polyodon*, f. 24, var. *longa*, p. 382, f. 25, and var. *curta*, p. 382.—WESTERLUND, Fauna, iii, 1887, p. 92, with form *echthrodes*, n. n. for var. *polyodon* Moq.—DUPUY, Bull. Soc. d'Hist. Nat. Toulouse, xiii, 1879, p. 54, with var. *polyodon* and var. *elongatissima*, p. 55. — CAZIOT, Ann. Soc. Linn. Lyon, Année 1916, p. 59. — *Helix dufourii* FÉR., Tabl.

Syst., p. 63, no. 478, no description, *teste* Beck, Ind. Moll., p. 83.—*Pupa dufourii* Dupuy, Hist. Moll. Fr., p. 400, pl. 20, f. 1. —*Orcula cylindrica* Mich., Locard, Ann. Soc. d'Agricult. Lyons (7), iii, 1896, p. 208.—Germain, Moll. de la France et des Rég. voisines, ii, 1913, p. 179.—*Sandahlia cylindrica* West., Synopsis, 1897, p. 77, with form *ectrodes*.

This species is easily known by the umbilicus, the closely wound whorls, and the long, strong folds of the aperture.

In typical *cylindrica* the right limb of the twinned angular lamella is long, extending inward beyond the anterior end of the parietal lamella.

The description and figs. 1, 2 are from specimens received from Michaud.

Caziot (1916) stated that this species is confined to the Spanish slope of the eastern Pyrenees, and at Villefranche-de-Confluent, Amélie-les-Bains, la Preste and Saint-Laurent-de-Cerdans on the French slope. In France it lives exclusively in the valleys of the Têt and the Tech. In Spain it descends as far as Montserrat, and penetrates very little westward.

The following forms and varieties have been described:

Var. *elongatissima* Dupuy. Shell of 15-16 whorls. La Preste.

Var. *longa* Moq. Shell of 14 whorls; aperture with 8 or 9 folds. Length 12 mm.; no locality given.

Var. *curta* Moq. Shell with 9-10 whorls; aperture much folded; length 5-6 mm. Arles. (See *S. c. curtata*.)

Var. *cylindriformis* 'Bgt.' Loc. Cylindric, much lengthened, relatively somewhat narrow; 12-13 slightly convex whorls, the suture little impressed; aperture relatively small, long-oval, the lateral borders subparallel; 2 superior folds, one in the vicinity of the suture, the other contiguous and immersed; 2 immersed columellars, the first a little narrow and long, the second shorter and a little less deeply placed; 4 palatals, the first rudimentary, the second the strongest, and the only one reaching the peristome; the two lower smaller; peristome interrupted, a little thickened, everted; shell dark corneous-red, ornamented with very fine, regular and crowded striæ. Length 8½-10, diam. 2½-3 mm. La Prats (Pyrénées-

Orientales), Rians (Var), etc. (*Orcula cylindriformis* Bourguignat in coll., Locard, Ann. Soc. d'Agric. Lyon (7), iii, 1896, p. 209.)

The locality Rians (Var) is surely an error, as this place is far out of the range of *Sandahlia* and in an Alpic fauna.

Form *echthrodes* West. (Var. *polyodon* Moq., not *Pupa polyodon* Drap.; form *echtrodes* West., 1897.) Shell of 11-12 whorls; aperture with several little folds between the ordinary ones. Villefranche.

Var. *corrugata* Loc. Cylindric-elongate, very rapidly tapering at the summit; 11-12 slightly convex whorls, the suture marked; aperture relatively small, long-oval; 2 superior folds, the first bifid, lodged at the suture, the second immersed; 2 columellars, attaining the peristome, accompanied by 2 to 4 little peristomial folds; 4 palatals, of which 3 attain the peristome, accompanied by 3 or 4 peristomial folds; peristome thick, expanded, reflected; shell corneous-fawn, not glossy, ornamented with very fine, regular and close striæ. Length 7-8, diam. 2¾-3 mm. Villefranche (Pyrénées-Orientales). (*Orcula corrugata* Locard, Ann. Soc. d'Agric. Lyon (7), iii, 1896, p. 209.)

This is probably equal to *echthrodes* W.

1*a*. *S. cylindrica curtata* n. subsp. Pl. 46, figs. 5, 7.

This form, which I take to be var. *curta* Moq.-Tand. (not *Pupa pyrenæaria* var. *curta* Moq., on a prior page), is a rather well-characterized subspecies. Besides the short shell, of which the last 4 whorls form the cylindric portion, it is peculiar in the aperture. The little right twin-lamella of the angular lamella is *very short*. The angular proper extends a little way beyond the anterior end of the parietal, and is *not continuous* with the spiral lamella, which, however, is well developed. The accessory lamellæ of columellar and parietal margins are often quite weak, or largely wanting. The inner barrier is dorsal.

Length 6, diam. above aperture 2.8 mm.; 10 whorls (type fig. 5).

Length 5.9, diam. above aperture 2.6 mm.; 9¾ whorls.

Length 6.9 mm. (largest specimen seen).

Genus ABIDA Leach.

Pupa Drap. and of most authors, not of Bolten 1798.—*Cochlodonta* Fér., in part.—*Chondrus* Cuvier, in part, Regne Animal, ii, 1816, p. 408. — Hartmann, in part, System der Erd- und Süsswasser-Conchyl. Europas, 1821, pp. 38, 50, etc.

Torquilla Studer, in Kurzes Verzeichniss der bis jetzt in unsern Vaterlande entdeckten Conchylien, Naturwissenschaftlicher Anzeiger der allgemeinen Schweizerischen Ges. f. gesammten Naturwissenschaften, 3ter Jahrg., 1 May, 1820, p. 89, for *variabilis* Drap., *secale* Dr., *avena* Dr., *hordeum* Stud. and *granum*(?) Drap. Not *Torquilla* Brisson, 1760 (*Aves*). —Gray, P. Z. S., 1847, p. 176, *Pupa secale* selected as type.

Abida Leach, in Turton's Manual of Land and Freshwater Shells of the British Islands, 1831, p. 101, monotype *Abida secale* Leach = *Pupa secale* Drap.

Granaria Held, Isis, 1837, p. 918; *Pupa variabilis* Dr. here selected as type. — *Pupella* Swainson, Malacology, 1840, p. 334; *P. variabilis* Dr. here selected as type.

Stomodonta Mermet, Hist. des moll. terr. et fluv. viv. dans les Pyrénées-Occidentales, 1843, p. 45. *Stomodonta secale* (*Pupa secale* Drap.) is here selected as type.

Jaminia Leach MS., Risso, in part, Hist. Nat. Eur. Mérid., iv, 1826, p. 88, and of some subsequent authors; not *Jaminia* as restricted by Gray, P. Z. S., 1847, p. 176, to the type *J. heterostropha* = *Bulimus quadridens* Brug.

The shell is relatively large (5 to 20 mm. long), cylindric with conic summit, pale brown, of calcareous texture, the aperture having long angular, parietal and columellar lamellæ, upper, lower and basal plicæ, and usually some accessory folds, the plicæ long, entering to or past the dorsal side; internal axis slender.

Radula having unicuspid or tricuspid central teeth, the laterals all distinctly bicuspid, with wide, square basal-plates; marginal teeth with additional cusps.

Type: *A. secale*. Distribution: Spain to Roumania, north to the Thames counties of England (possibly in Algeria also).

This genus differs from *Chondrina* by the more earthy shell and longer palatal plicæ, which frequently are enlarged at

their inner ends to form an interior barrier, as in pl. 43, fig. 3. The chief difference, however, is in the teeth of the radula, which are of the normal Pupillid type in *Abida*, strongly modified in *Chondrina*.

The Abidas show far less differentiation in form and apertural teeth than the Chondrinas. The genus is also less widely distributed, occupying only the central part of the *Chondrina* territory, which, except in England, surpasses that of *Abida* on all sides.

It had been planned to have *Abida* and *Chondrina* monographed by a European conchologist, but this proved to be impracticable under existing conditions. To omit these genera from their proper systematic place seemed unwise, as the monograph of Pupillidæ might thus be left incomplete for an indefinite time. Yet to really write a monograph of *Abida* and *Chondrina* one should give them some years of investigation; personally collect in several fields, especially in the Pyrenees, in order to get a true perspective of racial values. Finally, the collection of Bourguignat at Geneva should be assiduously studied. It is clumsy work attempting to estimate the species of Dupuy, Bofill, Fagot and other workers in this field, or reconcile their differences, without such preparation. Indeed, I do not presume to do so. It can only be expected of me that the well-established species be properly defined, and a reliable compilation made from the published literature on the others. It is a collection of materials rather than an authoritative monograph. Westerlund's helpful monographs of 1887 and 1897 have been used freely, but the present work comprises many more named forms. With few exceptions, the descriptions have been translated in full from original sources.

It must not be supposed that the "varieties" herein admitted represent the writer's views. They reflect merely the condition of the literature upon the group. In most cases I have not sufficient knowledge of them for the formation of an opinion. The term "var." leaves the question of status open, and may apply to any subspecific form, whether racial or merely individual variation. *A large proportion of the varietal names are invalid*, under existing rules of nomencla-

ture, on account of prior use of the same names in connection with other species of "*Pupa.*" I have rarely attempted to rectify the usage, because whoever thoroughly revises the subspecific forms zoologically ought to have a free hand with their nomenclature. Otherwise there will be further accretions to the already colossal synonymy.

The impression may be ventured that the forms described by Bofill and Fagot are mainly valid as species or races, while most of those of Locard have little value, or are practically synonyms. Bourguignat's work on the group is of very unequal value.

Much of the literature of the Pupillidæ of southern Europe is inadequate, either in description, in comparisons with figured species, in knowledge of previous work, or especially in lacking illustrations. The carelessness and incompetence of some authors are appalling. Yet there has been much excellent work also. Draparnaud laid a sure foundation. Küster, and especially Rossmässler in Germany, Moquin-Tandon in France, built with consummate workmanship. Of late years, Commandant Caziot and M. Margier have studied the distribution and synonymy of many species with excellent results; and there are many minor papers by other authors which it is a pleasure to use.

Radula.

The dentition has been investigated chiefly by Rev. Prof. Gwatkin, Proc. Malac. Soc. London, iii, p. 227. He gives the following list of species having the normal type of teeth:

affinis Rm.	muhlfeldii Küster.
avenacea Brug.	nana
braunii Rm.	pachygastra Ziegl.
cinerea Dr.	partioti Moq.-Tand.
clausilioides Boub.	rhodia Roth
frumentum Drap.	secalina Marts.
montserratica Fag.	variabilis Drap.

Some of the specimens supplied to Prof. Gwatkin must have been identified incorrectly. Thus, *avenacea* and *cinerea* (under

the names *quinquedentata* and *similis*) appear also in his list of species having the *Chondrina* type of teeth. Both species have been investigated by Schako and by the author. They belong unquestionably to *Chondrina*. *P. muhlfeldii* is stated by Schako to have teeth like *avenacea*, and is therefore a *Chondrina*. *Pupa secale*, which Prof. Gwatkin has in his list of species with teeth like *Chondrina megacheilos*, certainly belongs to the normal or *Abida* group, as I have examined several radulæ. It has a simple mesocone alone on the centrals, but all the laterals have the ectocone, though smaller than in some other species. There are about 12 laterals, of the broad quadrate type. In *Chondrina* the laterals are more numerous, narrow, with single long, curved cusps. *A. frumentum* has fewer laterals, 5, with larger ectocones, and there are very weak ectocones on the centrals.

Apertural Teeth.

Most species of *Abida* and *Chondrina* possess a special lamella peripherad of the inner end of the parietal lamella, called the *spiral lamella*, shown at *s* in pl. 42, fig. 4, also in the other basal views on that plate, and in pl. 43, fig. 1, and others. The spiral lamella is a disjoined portion of the angular lamella, with which it is continuous in some species. It is often absent. Although first noticed by Küster many years ago, most authors have ignored it, thus losing a useful character. It may generally be seen in an oblique view in the mouth, though of course not in the usual ventral view given in figures. In some cases it is not visible without breaking the shell (as in pl. 43, fig. 1).

The angular lamella is often duplicated or twinned by the development of an accessory lamella outside of it, towards the suture, shown in plate 42, figs. 8, 14, 16. In some species there is a low lamella at the columellar end of the parietal wall, as in pl. 43, fig. 14. *Abida polyodon* has a *parallel lamella*, situated between the spiral lamella and the suture, on the parietal wall, shown in pl. 44, fig. 3. The principal lamellæ and plicæ of these genera are otherwise placed exactly as in *Gastrocopta*, etc. There is more or less thickening or in-

bending of the outer lip where the upper palatal plica or fold emerges.

Many French authors call the lamellæ of the parietal wall "superior folds" (plis supérieurs).

Distribution.

While species of *Abida* occur from Spain to the Balkans, and north to southern England, they are chiefly concentrated about the Alps and the Pyrenees, which have been evolution centers of species and races. *A. secale* (with its immediate relatives or races) covers nearly the whole range of the genus and extends far north of all other species, but the other groups of species are more local.

I. Pyrenean center: Groups of *A. polyodon, A. braunii* and *A. affinis.* Three rather closely related groups, allied to the Alpic *frumentiana.* In this connection it may be noted that *Sandahlia cylindrica* appears to be merely a special modification of the same ancestral stock. *A. polyodon* has spread as far east as the Var valley in France, but most of the species are strictly mountain forms of the Pyrenees. The western limit of the genus in Spain has not been worked out.

II. Alpic center: Groups of *A. frumentum, A. micheli, A. variabilis* and *A. atracta.* These groups are more distinctly differentiated than the Pyrenean. *A. frumentum* has the most extensive range, second only to that of *A. secale,* which is perhaps also to be classed as belonging to the Alpic center. Some other forms, such as *A. variabilis,* overlap the ranges of a few Pyrenean species in southern France, but none extends as far west as the Pyrenees. The related genus *Odontocyclas* also belongs to the Alpic center.

The conclusions to be drawn from the distribution of both *Abida* and *Chondrina* are in agreement. The Pyrenean (or Hispanic) center is rather a secondary or peripheral center of evolution, so far as the modern forms are concerned. Though remarkably rich in species and races, the differentiation is of somewhat more youthful type than around the Alpic center.

The alleged occurrence of *Abida braunii* and *A. polyodon*

in Algeria, reported by Bourguignat (*Malacologie de l'Algerie*), is really remarkable. The records are so definite that one may scarcely express doubt, whatever may be felt; yet further confirmation would certainly be comforting. *Chondrina goniostoma, C. penchinatiana* and *C. avenacea* are other equally anomalous records from Bourguignat and from Letourneux (*La Kabylie*, i, p. 227). Except *C. avenacea*, these species belong to the Pyrenean center, most of them being distinctively mountain forms. Until these Algerian records shall be confirmed in the field, speculation upon them is unprofitable.

It will be noted that the area of *Chondrina* extends both east and west of that of *Abida*, also being found further south (in Sicily and Morocco), and further north (Oeland and Gotland. Except in England, the area of *Abida* is everywhere surpassed by *Chondrina*. Since there is also much more structural diversity among the Chondrinas, there is some reason to believe it older as a genus; though of course the specialized radula forbids the idea that it was ancestral to *Abida*.

Nomenclature.

The generic term *Pupa* was first used by Bolten in the posthumous Museum Boltenianum, 1798, p. 110, for *Pupa solidula* (n. n. for *Voluta flammea* Gmel.) and *Pupa grisebla* (n. n. for *Voluta solidula* Gmel.). The second of these species, *P. grisebla*, may be selected as type of *Pupa*. That term therefore displaces the names of the Tectibranch genus *Solidula* F. de W. (see Man. Conch., 1st ser., xv, p. 136), which will be known as *Pupa* Bolt.

Lamarck, in Syst. Anim. sans Vert., 1801, p. 88, proposed to use *Pupa* for a series of land shells, giving *P. uva* as an example. *Pupa* Lam., with the type *uva*, becomes therefore a synonym of Cerion Bolt.,* 1798 (Mus. Bolt., p. 90; Man. Conch., 2d ser., xiv, 174).

* *Cerion* contained the following Boltenian species:

C. vulgare Bolt., based on figures of *C. mumia* and *C. uva*; here restricted to the latter.

C. uva Bolt. based on Gmelin, together with figures possibly of *C. multicosta* K.

Stomodonta Mermet was a composite genus, formed by the union of the prior genera *Clausilia, Pupa* and *Vertigo,* which Mermet considered to be not generically distinct. *Pupa secale* Drap. is here selected as its type.

Jaminia of Risso was a heterogeneous group. It has been discussed by Woodward, Journ. of Conch., 1903, p. 358, Cockerell (Nautilus, xviii, p. 103), Dall (Nautilus, xvii, 115, xviii, 114) and Pilsbry (Nautilus, xviii, 105, 117), but Gray had already selected a type in 1847. According to existing rules governing nomenclature, a type once properly selected cannot be altered, and Gray's action removed *Jaminia* from the Pupillid group. It will displace *Chondrula* Beck in the Buliminoid series.

Abida and *Chondrina* have generally been known as *Torquilla*—a name long before used for a genus of birds. *Chondrus* of Cuvier included species of *Abida,* but the type species, *zebra* Oliv. (selected by Gray, P. Z. S., 1847, p. 175), belongs to the Buliminoid group generally known by the later name *Brephulus.* Hartmann's use of *Chondrus* for the Abidas (1821) was not a restriction of Cuvier's group, as he did not recognize its composite nature or name a type. See notes under *Chondrina.*

Tertiary Species of Abida and Chondrina.

The paleontology of *Abida* and *Chondrina* is little known. The earliest forms are *A. vouastensis* of northern France (Oise), considered by Raspail to be of Bartonian Eocene age, and much like the recent *frumentum;* an undetermined Middle

C. apiarium Bolt.=*uva* Gmel.=*uva* L. Type of *Cerion.*

C. pupa Bolt.=*Helix pupa* Gm., a species of *Mastus* (Enidæ).

C. botrys Bolt. undetermined.

C. bidens Bolt.=*Turbo bidens* Gmel., a *Clausilia.*

Synonyms of *Cerion* are: *Cerium* Link, Beschreib, Rostock Sammlung iii, 1807, p. 131, for *C. uva* and *C. bidens,* the former the type. *Puparia* Rafinesque, Analyse de la Nature, 1815, p. 143, new name for *Pupa* Lam., therefore taking the same type, *P. uva.* Férussac included the Abidas, as well as *Orcula, Pupilla, Cerion* and other groups under the subgenus *Cochlodonta.* It is proposed to make the species *uva* Linn. type of *Cochlodonta,* which therefore becomes equivalent to *Cerion* Bolten.

Oligocene species of the Main Basin, known by fragments generically characteristic, and *Abida oryza* Edw., also quite imperfectly known. These were followed in the Upper Oligocene and Miocene by German and Bohemian species which Dr. Boettger considered closely related to the recent *A. variabilis*. All of these forms have the shape, size and characteristic lamellæ and folds of the modern genus. The origin of the group is thus to be looked for in earliest Tertiary or more likely in Cretaceous time. The rarity of specimens and small number of species indicate either that central Europe was on the confines of the distribution of the genus, or that the species, then as now, lived chiefly in mountainous regions, and were only preserved exceptionally.

The only Tertiary Chondrinas found on record are so doubtfully referred to that genus that no conclusions can properly be based upon them.

ABIDA VOUASTENSIS (Raspail). *Pupa vouastensis* Raspail, Feuille Jeunes Naturalistes, 1909, no. 466, p. 201. Bartonian(?) stage of the Eocene, Vouast, near Montjavoult (Oise).

ABIDA ORYZA (Edwards). *Pupa oryza* EDW., Mon. Eoc. Ceph. and Univalves of England, i, 18—, p. 78, pl. 14, f. 3*a–b*. Oligocene, Headon Hill.

ABIDA *sp.* BOETTGER, Jahrb. Nassau. Ver. Naturk., xliii, 1889, p. 245 (as *Torquilla sp.*). Middle Oligocene of Elsheim in Rheinhessen.

ABIDA SUBVARIABILIS Sandb. *Pupa subvariabilis* Sandberger Conchyl. Mainz. Tertiär Beckens, 1863, p. 50, pl. 5, f. 6-6*c*; Vorwelt, p. 393, pl. 23, f. 6–6*c*.—*Pupa variabilis* var. *miocaena* A. Braun, Vert. d. Naturf. Vers. zu Mainz, 1842, p. 148. —*Torquilla subvariabilis* (Sndbgr.) Boettger, Jahrb. Nassau. Ver. Naturk., xlii, 1889, p. 243. — SCHLOSSER, Abhandl. d. naturw.-med. Ver. für Böhmen "Lotos," ii, 3. Heft, 1901, p. 93, var. *ulmensis*. Upper Oligocene, Hochheim, Eckingen.

ABIDA INTRUSA (Slavik). *Pupa intrusa* SLAVIK, Archiv pro prirod. prozk. Cech., i, 2, p. 259, pl. 4, f. 12, 13.—*Torquilla intrusa* Slavik, KLIKA, Die Tert. Land- und Süsswasser-Conchyl. des nordwestlichen Böhmen, 1891, p. 87, f. 83. Upper Oligocene, Tuchoritz [Tuchorschitz] and Lippen.

ABIDA FUSTIS (Boettger). *Torquilla fustis* Bttg., Jahrb. Nassau. Ver. Naturk., xlii, 1889, p. 246. — *Pupa* (*Torquilla*) *subvariabilis* SANDB., in part, Vorwelt, p. 393, pl. 23, f. 6–6*c*. Upper Oligocene Landschneckenkalk von Hochheim.

ABIDA ANTIQUA (Schübler). *Pupa antiqua* Schübl. in Zieten, Verst. Württembergs, p. 39, pl. 29, f. 7. — SANDBERGER, Vorwelt, p. 653.—*Pupa schübleri* KLEIN, Jahresh. Ver. Naturk. Württemb., ii, 1847, p. 74, pl. 1, f. 18.—MILLER, Jahresh. Ver. Vaterl. Naturk., vol. 56, 1900, p. 396, with var. *pachygastra* Fraas, p. 397. Middle Miocene, Kalksande von Steinheim am Aalbuch.

ABIDA SUBANTIQUA Lomnicki. *Pupa subantiqua* LOM., Verhandl. k. k. Geol. Reichsanst., 1886, nr. 16, p. 423. Miocene, Folwarki, Galizia.

ABIDA NOERDLINGENSIS (Klein). *Pupa noerdlingensis* Klein, Jahresh. Ver. Vaterl. Naturk. Württemb., ii, 1847, p. 75, pl. 1, f. 20.—*Torquilla noerdlingenensis* (Kl.) BOETTGER, Jahrb. Nassau. Ver. Naturk., xlii, 1889, p. 245. — *Pupa* (*Torquilla*) *subfusiformis* Sandberger, Vorwelt, p. 598. Upper Miocene, Germany.

Series of A. polyodon.

Plicæ and lamellæ strongly developed, with many intermediate folds. Angular continuous with the spiral lamella; a parallel lamella present. Pyrenean center, but extending across southern France.

1. ABIDA POLYODON (Drap.). Pl. 44, figs. 1, 2, 3.

The shell is cylindric below, the upper half or less conic, apex obtuse; cinnamon or somewhat darker, thin, very finely, distinctly striate; upper whorls convex, the later much less so, the last whorl somewhat compressed near the base, whitish or buff near the lip, the suture ascending slightly at its end. The aperture is shortly oval. Angular lamella straight in front, entering deeply, and weakly continuous with the spiral lamella, which is curved, and attains a dorsal position, deeper than the parietal lamella. A short twin accessory lamella stands between the angular and the outer lip, and far within there is a small "parallel lamella" between the spiral lamella

and the suture (pl. 44, fig. 3). The parietal lamella is deep within, low in front but high within. A slender lamella stands close to the columellar insertion. Columellar lamella strong within, emerging and ascending obliquely to the peristome. Subcolumellar lamella smaller, descending and emerging. Upper and lower palatal and basal plicæ strong, emerging, becoming lower within, and again enlarging to form an inner barrier in a dorso-lateral position, where there is also a short suprapalatal and a smaller sutural plica. The peristome is somewhat expanded, whitish, its internal callous sculptured with few or (typically) many narrow folds.

Length 8, diam. 2.8 mm. (typical form, fig. 2).

Length 9.8, diam. 2.8 mm. (long form, fig. 1).

France: in the olive zone, east to the Var valley, north to Grenoble in the Isère valley, but on the west side of the Rhone not beyond the Ardèche river; west to the Pyrenees. Type locality, Castelnau, near Montpellier.

Spain: Pyrenees, and in the Mediterranean drainage southwest to the province of Murcia; Minorca.

Pupa polyodon Draparnaud, Tableau, 1801, p. 60; Hist. Moll. France, p. 67, pl. 4, f. 1, 2.—Rossmaessler, Iconogr., i, pt. 5, p. 12, f. 316.—Kuester, Conchyl. Cab., *Pupa*, p. 42, pl. 5, f. 24, 25. — Pfeiffer, Monogr., ii, 336. — Moquin-Tandon, Hist. nat. Moll. Fr., p. 372, pl. 26, f. 39; pl. 27, f. 1-4, with var. *attrita*, p. 373.—Bourguignat, Malac. de l'Algérie, ii, p. 77, pl. 5, f. 14-18 (flood debris of the ravine Chabat-Beinan, near Cape Caxine, Algeria). — Caziot et Fagot, Ann. Soc. Linn. Lyon, n. sér. liii, 1907, p. 192. — Caziot, Etude Moll. Monaco, etc., 1910, p. 321; Bull. Soc. Zool. France, xxxv, 1910, pp. 94-98.—*Chondrus polyodon* Cuvier, Règne Animal, ii, p. 408. — *Granaria polyodon* Held., Isis, 1837, p. 918. — *Pupa montserratica* Fagot, Annales de Malacologie, ii, 1884, p. 191.

Abida polyodon is readily known by the many denticulations of the peristome, which are strongest in the Pyrenean race *ringicula*, and sometimes weak and partly wanting in French examples. At all times the internal structure is characteristic, the spiral lamella being continuous with the angular, and penetrating beyond the parietal lamella, and *a small*

parallel lamella is developed (near the suture, outside of the spiral lamella). There is also a suprapalatal and a sutural plica.

The distribution has been considered in detail by Commandant Caziot in two papers referred to above. He doubts the Algerian record of Bourguignat. In the foothills of the Pyrenees the typical form gives place to the var. *ringicula*, which extends over the range into southeastern Spain.

Var. *attrita* Moquin-Tandon, 1855. Shell smaller, aperture with the folds very inconspicuous. Montpellier.

Var. *ventricosa* Locard. Shell smaller, ventricose (*Westerlund*, Synops., 1897, p. 87).

Var. *montserratica* Fagot. Differs from *polyodon* by the more rounded perforation, the smaller aperture, the spire slimmer and longer, as in *Pupa secale*, and by the feebler denticulations, which are arranged almost in the same way. Length 9, diam. 2¼ mm., 9½ whorls. Monastery of Montserrat, Catalonia, Spain, on rocks (*Fagot*).

Var. *amelix* 'Bgt.,' Loc. Small, ovoid, rather short, stout and ventricose, rapidly tapering above. Seven to eight quite convex whorls, the suture marked. Aperture small, somewhat rounded, a little contracted; 3 to 4 superior folds, 2 columellars; 4 palatals; 7-8 little peristomial folds. Peristome very slightly expanded, rather thin. Shell corneous-red, subopaque, but little shining, ornamented with quite well marked, fine and regular striæ. Length 6½–7, diam. 2½ mm. Rare; Amélie - les - Bains (Pyr.-Or.); Avignonnet (H. - Garonne). *Pupa amelix* Brgt. in coll., Locard, Ann. Soc. de l'Agricult. Lyon (7), iii, 1896, p. 198.

Var. *ringicula* (Mich., Kuester). Pl. 44, fig. 4. Aperture oblong, subangular at base, the little folds of the peristome distinct and numerous. Length 3½, width 1⅓ lines. Locality: in the eastern Pyrenees (*Kuester*).

Pupa ringicula Michaud in litt., Kuester, Syst. Conch. Cab., *Pupa*, 1849(?), p. 103, pl. 14, f. 9-12, quoted in synonymy of P. polyodon var. minor.—*P. polyodon* var. *minor* Rossm., Iconogr., pt. xi, 1842, p. 10, f. 727.—*Pupa polyodon* var. *ringicula* Michaud, Westerlund, Fauna, iii, 1887, p. 116.

—*Pupa ringicula* Michaud (as a form of *polyodon*), CAZIOT, Bull. Soc. Zool. France, xxxv, 1910, p. 97 (distribution).—*Helix* (*Cochlodonta*) *polyodon* var. *a:* "exilis, elongata," FÉR., Tableau Syst., 1821, p. 60, no. 490 (Gironne, Barcelonne) = *Torquilla gracillima* BECK, Index Moll., 1837, p. 86, no. 17. = *Pupa polyodon* var. *exilis* Moquin-Tandon, based upon same reference to Férussac.—*Pupa p.* var. *minor* Moq., 1855, based upon Rossm., f. 727.

According to M. Margier, the *Pupa ringicula* is characteristic of the valleys of the departments Aude and Pyrénées Orientales. It has been found at Carcassonne and Candiès, Villafranche-de-Confluent, Amélie-les-Bains; but in the upper part of the valley of the Tech it is replaced by *Pupa montserratica*, at La Preste, Prats-de-Mollo, Arles-sur-Tech. The two forms do not occur together. In Spain it is abundant in the provinces composing Aragon, in Catalonia, and has been found as far southwest as the province of Murcia.

The separation of this variety from *polyodon* seems arbitrary, as the sizes intergrade. Draparnaud's type of *polyodon* from near Montpellier was 8.5 mm. long. Specimens, presumably of the var. ringicula, from dep. Hautes-Pyrénées measure 6.4 mm. long, others from Barcelona (fig. 4) up to 9.7 x 3.2 mm.

Torquilla gracillima Beck defined by the two words *exilis, elongata*, may have been a slender shell of this race.

Series of A. braunii.

Rather small, closely striate, with 4 palatal plicæ, the upper and sometimes the basal short, not emerging. Lip thick. Pyrenean center.

5. ABIDA BRAUNII (Rossm.). Pl. 43, figs. 1 to 6.

Shell with a narrow but distinct, half-covered umbilical perforation; rather small; ovate-oblong, with rather acute summit, corneous-buff, transparent, nearly lusterless, strong, very finely and indistinctly striate. The 7 whorls are strongly convex and united by a deep suture. Aperture half-ovate; peristome expanded, with a distinct white lip, the outer lip

somewhat arcuately impressed. In the middle of the palate stand two very long palatal plicæ, which deep in the throat are thicker and more emphatic for a short distance; at the same place a very short but emphatic plica stands under, another over the two long palatal plicæ (pl. 43, fig. 3). On the columella there is a very distinct, and under it the scarcely visible rudiment of a second tooth. On the parietal wall there are two lamellæ, of which the outer connects anteriorly in a curve with the beginning of the outer lip. Length 2½, diam. 1 line; 7 whorls. (*Rossm.*)

France: Valley of Luz (Hautes-Pyrénées) and Coustouge (Pyrénées-Orientales). Spain. Also has been reported from Portugal and from Algeria, and Algiers in debris of the Oued-Isser and Oued-Staouéli, and of the small ravine of Chabet-Beinan near Cape Caxine (Bgt.).

Pupa braunii ROSSMAESSLER, Iconogr. L. u. Süswasser-Moll. ii, xi Heft, 1842, p. 10, pl. 53, f. 726, *a*, *b*, *c* (Carcassonne).—KUESTER, Conchyl. Cab., p. 86, pl. 12, f. 14-16.—MOQUIN-TANDON, Hist. Moll. Fr., p. 377, pl. 27, f. 10-14, with varr. *cycloides* and *multidens*.—PFEIFFER, Monogr., ii, 334; iii, 545; iv, 671; vi, 311; viii, 379.—BOURGUIGNAT, Malac. de l'Algerie, ii, 1864, p. 81, pl. 5, f. 28-32, with var. *major*, p. 82, and var. *crassilabrum*, p. 83, pl. 5, f. 33, 34.—WESTERLUND, Fauna, iii, 1887, p. 108.—*Pupa labiosa* MOQUIN-TANDON, "Mém. lu à l'Acad. des Scienc. Toulouse, juillet, 1842."

The inner set of plicæ is strongly developed, very deeply immersed, between the left side and dorsal position; the upper palatal and the basal plica appear here only, the latter as a small, short fold. Inter- and lower palatal run to the lip, and there is a short sutural fold, represented by a mere trace. The parietal lamella is a half whorl long, terminating abruptly at the inner barrier, where also a very short spiral lamella stands. The columellar lamella penetrates inward to the ventral position. Subcolumellar lamella is wholly immersed, dorsal, rather well developed, though much smaller than the columellar. There is an opaque white band behind the lip, which is strongly thickened within. The base of the shell is rounded.

Length 5.8 to 6.8, diam. 2.3 mm.; 8 to nearly 9 whorls.

The records of this species in Portugal and Algeria, made about fifty years ago, have not been confirmed by later collections, so far as I can learn. A. Nobre, a careful observer, could give no confirmation of the record from Portugal, in his work of 1908. Its range in Spain is probably not greater than that of *A. polyodon*.

Rossmässler's figures (pl. 43, figs. 4-6) represent a shell with shorter terminal cone than those I have seen from Luz and Bareye (Hautes-Pyrénées) and Spain. The parietal callous seems to have been very thin. In most of the specimens I have seen it is quite distinct or even forms a distinct ledge. Often there is a small denticle at each end of the parietal callous, or its whole extent may be cut into low denticles (pl. 43, figs. 1, 2, Luz). Rossmässler's locality, Carcassonne, was erroneous. According to Moquin-Tandon (p. 378), Braun, who supplied Rossmässler's types, obtained it at Baréges. It is quite abundant, though only in certain localities, around Saint-Sauveur.

Moquin-Tandon defined two varieties, both from Luz: *cycloides*, shell with the peristome continuous; and *multidens*, shell with the peristome subcontinuous, aperture with a small tooth on the penult whorl near the columellar margin, 2 columellar lamellæ; the lower palatal plica more strongly developed. According to Westerlund (Malak. Bl., vol. 22, p. 122) the var. *multidens* is a synonym of *P. partioti*. Yet as that species was well known to Moquin-Tandon, the reference appears dubious.

Var. *conispira* Westerlund. Shell gradually elongate-conic from the wide and somewhat transverse base, acute, greenish-white, densely, regularly costulate; 8½ whorls very slowly increasing. Aperture situated wholly below the external half of the base; angular lamella very small, parietal long, columellar fold very short, strong. Length 6, diam. at the base 3 mm. Albarrasin, Spain (*Westerl.*, Nachrbl., 1893, p. 120; Synops. Moll. Extramar. Reg. Pal., i, 1897, p. 87).

Var. *major* Bgt. Shell of a little greater size, length 8, diam. 3 mm. Algeria: Oued-Staouéli (*Bourguignat*).

Var. *crassilabrum* Bgt. Shell resembling the type, but the

peristome is thicker, wider, as though bloated, with very blunt edges. Algeria: Chabet-Beinan, Oued-Staouéli (*Bourguignat*).

6. Abida partioti (Moq.). Pl. 43, figs. 7, 8, 9.

The shell is minutely perforate, obliquely rimate, cylindric below, the upper half or more slowly tapering to an obtuse apex; between tawny and cinnamon-brown; evenly and minutely rib-striate. Whorls slightly convex, the last whorl having a *short, horizontal, strongly projecting basal carina*, and a shallow spiral impression on the last half, over the upper palatal plica; suture suddenly ascending at the end. Aperture semioval. Angular lamella thickened and joining the outer lip, long, penetrating deeply to the spiral lamella but not quite joining it; spiral lamella short and in a dorsal position (see fig. 7). Parietal lamella rather deeply immersed, not high, running to the dorsal side. The columella is strong, subhorizontal, and a half whorl long; subcolumellar smaller, more oblique within; both continue nearly to the peristome, the lower more strongly. Three long plicæ emerge to the peristome, the upper palatal running into the callous defining the sinulus. In the middle of the back the plicæ are emphasized, forming short teeth, a short suprapalatal fold standing above them. The peristome is expanded, well thickened within and on the face. The parietal callous is crenulated by the striæ, and usually has some denticles, those at the two ends larger and more constant. Length 6.7, diam. 2.3 mm.; 10 whorls.

"Length 6 to 8, diam. 1.8 to 2 mm." (*Moq.*).

Pyrenees: Valley of Luz, near the Gontaut bridge (Partiot); bottom of the cirque de Gavarnie (Saint-Simon).

Pupa partioti Moquin-Tandon, in Saint-Simon, Miscellanées Malacologiques, i, 1848, p. 28.—Moll. France, p. 369, pl. 26, f. 30-33.—Kuester, Conchyl. Cab., *Pupa*, p. 114, pl. 15, f. 21-25.—Pfr., Monogr., iii, p. 546.—Dupuy, Hist. Moll. Fr., p. 383, pl. 19, f. 1.—Westerlund, Fauna, 1887, p. 109.—Kobelt, Iconogr. n. F., ix, 1902, p. 71, pl. 262, f. 1697.

Distinguished by the basal keel, the long angular lamella, etc. It is said to be very local in distribution. Examples from Luz are illustrated.

7. ABIDA TUXENSIS ('Fag.' West.).

Shell elongate, cylindric, shortly tapering above, corneous or rufous-brown, densely, arcuately and obsoletely, obliquely striatulate. Whorls 11, all very slowly increasing, a little convex, the last a little compressed at base, above strongly and very shortly ascending to the aperture. Aperture oval, with 8 folds, 2 parietal, 2 columellar, 4 palatal; the angular fold duplicated at the insertion; parietal deeply placed, high; upper columellar very strong within, outwardly thinly tapering or with a tubercle placed against the margin, the lower fold thin and short; first palatal fold short, generally punctiform, the two middle folds equal, larger, submarginal, the basal fold shorter. Peristome a little reflected, whitish, margins joined by a very thin parietal callous. Length 9½–10, diam. 2½ mm. (*West.*).

Spain: Tuxon, Catalonia (P. Fagot).

P.[*upa*] (*Torquilla*) *tuxensis* Fag. *in sc.*, WESTERLUND, Nachbl. d. Mal. Ges., 1902, p. 40.

A very large species of the *P. partioti* group (*West.*).

8. ABIDA DUPUYI (Westerl.). Pl. 43, fig. 10.

Shell oblong-cylindric, very delicately rib-striate, buff-corneous; whorls 9-10, slowly increasing, the upper convex, lower slightly so, the last whorl having two longitudinal furrows, the base below the perforation ornamented with a high, sharp-edged crest projecting as far as the subreflexed peristome. Aperture semioval; one angular lamella, thickened or duplicated by a denticle above; one deeply placed parietal lamella; one deeply placed, high columellar, situated in front of the parietal wall, and another, lower lamella, long, curved, running to the margin; palatal plicæ 3, long, the upper one very long, swollen tooth-like in the outer margin. Peristome scarcely expanded, thin in the upper outer part, the rest broadly expanded, thickened, white-lipped. Length 6, diam. 2 mm. (*Westerlund*).

France: Saint-Sauveur (Hautes-Pyrénées).

Pupa dupuyi WESTERLUND, Malak. Bl., xxii, 1874, p. 58, pl. 2, f. 5-7. Not *Vertigo dupuyi* of Michaud. — *Pupa cristella*

WESTERL., Fauna, etc., iii, 1887, p. 108; Synops. Moll., 1897, p. 88.—KOBELT, Iconogr. n. F., ix, 1902, p. 70, f. 1695.—*Pupa occidentalis* Bourguignat in coll., *teste* LOCARD, Ann. Soc. d'Agricult. Lyon (7), iii, 1896, p. 201.

The figure of this species is copied from Kobelt. It appears to be very closely related to *partioti*. The name *Pupa dupuyi* was not preoccupied, as Westerlund supposed, Michaud's species having been described as a *Vertigo*.

9. ABIDA RINGENS (Mich.). Pl. 43, figs. 12 to 15.

Shell perforate, cylindric, shortly conic near the summit, reddish horn-color or grayish, sharply and closely striate. Whorls 9, very slowly increasing, somewhat convex, the last swollen near the suture, flattened in the middle, *weakly compressed below*, suddenly ascending above. Aperture oval-*rounded*, with 9 lamellæ and plicæ. Parietal lamellæ 4 (two strong and high on the right, two small and marginal on the left). Columellar lamellæ 2 (the upper very long, strong and marginal, the second only a little shorter). Palatal plicæ 4 (the upper punctiform, deep within, 2d, 3d and 4th long, the 2d marginal, the 4th wholly basal; sometimes there are several small plicæ between the large ones on the wall and columella). Peristome whitish, *thin*, scarcely expanded, the margins delicately connected; columellar margin arcuate, the outer margin very strongly arcuate above (*forming a nearly circular sinulus* by the nearly touching angular lamella and 2d palatal plica); drawn forward in the middle. Length 6, diam. 2.5 mm. (*Westerlund*).

French Pyrenees: from l'Ariège to Gavarnie; type loc. Bagnères-de-Bigorre.

Pupa ringens MICHAUD, Complement de l'hist. nat. Moll. terr. et fluv. France, 1831, p. 64, pl. 15, f. 35, 36.—Kuester, Conchyl. Cab., *Pupa*, p. 99, pl. 13, f. 24-26.—PFR., Monogr., ii, 337; iii, 545; iv, 672; viii, 381. — MOQUIN-TANDON, Moll. France, p. 362, pl. 26, f. 16-21.—WESTERLUND, Malak. Bl., xxii, p. 65; Fauna, iii, 1887, p. 108.—CAZIOT, Ann. Soc. Linn. Lyon, Année, 1916, p. 58.—*Pupa pyrenaica* BOUBÉE, Bull. du l'Hist. nat. de France, i, 1833, p. 9 *bis* (not seen).

According to Caziot, it extends from Bastide-de-Serou (Ariège) to the Atlantic, and is represented in the extreme west (Bayonne) by the form *baillensi* Dupuy, which reaches Orduna, in the Basque Province of Spain. It does not live on the southern slope of the Pyrenees.

The figures represent a specimen received from Michaud. The palatal and basal plicæ do not penetrate so far as in *A. partioti*, falling short of the median dorsal line, the minute denticle representing the suprapalatal fold being more lateral than dorsal. The angular lamella is continuous, in a slender cord, with the spiral lamella, which therefore does not exist as a distinct lamella. The inner ends of this and the parietal lamella are together and short of the dorsal line. The typical form of *ringens* (figs. 12-14) has some small accessory denticles on the parietal wall and peristome, but these are quite inconstant, and often wanting, as in fig. 15. Westerlund, whose description is given above, mentions two slender parietal lamellæ at the left (near the columella), but in several lots seen there is but one; also in Michaud's figure. The original description follows.

Shell cylindric, ventricose, obliquely striate, umbilicate, ashy-corneous; whorls 8 or 9, convex; aperture semilunar, coarctate; peristome reflected, white, triplicate; lip angulate, labium biplicate; columellar callous, triplicate, the middle fold interior; all the folds are white; apex obtuse. Length 3 lines, diam. 1½ lines. Bagnères de Bigorre (Hautes-Pyrénées). (*Michaud.*)

Var. *elongata* Moq. Shell longer and less swollen. Bigorre.

Var. *pulchella* Moq. Shell smaller and less swollen. Cauterets; Saint-Sauveur.

Var. *disjuncta* Moq. Shell of the same size (5-6 mm. long, 2½-3 mm. wide), the peristome not continuous. Cauterets and Saint-Sauveur.

Var. subringens (Fagot). Narrowly elongate, a little ventricose, slowly tapering upward; 8 to 9 slightly convex whorls, the last compressed laterally. Aperture narrowly oval; 3 superior folds, the median much immersed, the last lodged in the columellar angle, sometimes another little rudimentary

fold far up in the middle; 2 columellars, the first larger, it only attaining the peristome, the upper being stronger; peristome continuous, but little thickened, slightly reflected. Length 7, diam. 2½ mm. (*Locard*).

Basses-Pyrénées: Eaux-Bonnes.

Pupa subringens Fagot, Malac. Pyr., 1892, p. 98.—Locard, Ann. Soc. d'Agric. Lyon (7), iii, 1896, p. 200.

No sufficient distinction from *A. ringens* has been made apparent.

Abida ringens bigerrensis Moq. Pl. 43, fig. 11.

Shell of the same size as the type (5-6 mm. long); peristome not continuous; aperture lacking the little fold on the penult whorl [parietal wall] alongside the columella (*Moq.*).

Bagnères-de-Bigorre (Hautes-Pyrénées).

Pupa bigoriensis Mich., Rossmaessler, Iconogr., i, pt. 5, 1837, p. 14, pl. 23, f. 321; not of Des Moulins. — *Granaria bigoriensis* Held, Isis, 1837, p. 918.—*Pupa ringens* Kuester, Conchyl. Cab., p. 50, pl. 6, f. 19, 20.—*Pupa ringens* var. *bigerrensis* Moquin-Tandon, Moll. France, 1855, p. 362, pl. 26, f. 21.—*Pupa bigerrensis* Moq., Westerlund, Malak. Bl., xxii, p. 66. — *Pupa fagotiana* Locard, Prodr. Mal. Fr., in Ann. Soc. Agricult. Lyon (5), iv, 1882, p. 438; Ann. Soc. d'Agricult. Lyon (7), iii, 1896, p. 199.—*Pupa ringens* var. *rossmässleri* Fagot, Moll. Haut.-Pyr., 1880, p. 13; Bull. Soc. d'Hist. Nat. Toulouse, xiv, 1880, p. 204 (not *P. rossmässleri* Schmidt).

The name *P. bigoriensis* had been applied (as *bigorriensis*) to another species prior to Rossmaessler's use of it; *bigerrensis* Moq. was not stated to be an emendation, it was a substitute; and as such it is sufficiently distinct to be retained. The names substituted by Locard and Fagot are superfluous. Some authors allow the form specific rank.

10. Abida baillensi (Dupuy).

Shell ovate-conic, rather ventricose, obliquely, regularly and finely striate, horn-buff. Whorls 7, somewhat convex. Aperture semi-ovate, *broadly rounded basally*, with 8 lamellæ and plicæ. Three parietal lamellæ (one within, in the middle,

the others in the right and left angles), two columellar lamellæ (the upper horizontal, long; second obliquely ascending, short). Three plicæ, the basal one tooth-like. Margins separated (or very weakly united); outer margin more strongly arcuate above. Length 4-5, diam. 2-2½ mm. (*Westerlund*).

Basses-Pyrénées: Banks of the Adour and le Gave de Bayonne, Orthez; woods behind the chateau de Cassaber à Caresse (Dupuy); on nummulitic limestone scarps between le Moulin d'Esbone et le Boucau (Folin); Garonne valley in Haute-Garonne (Fagot).

Pupa baillensi Dupuy, Revue Agricole et Horticole du Gers, 1873, p. 3, fig. (not seen).—Westerlund, Fauna, iii, 1887, p. 109.—Folin, Le Naturaliste (2), iii, 1889, p. 167, fig.—*Pupa baillensis* Dup., Westerlund, Malak. Bl., xxii, 1874, p. 122.—*Pupa baillensi* var. *garumnica* Fagot, Bull. Soc. d'Hist. Nat. de Toulouse, 1877, p. 45.

This form, which I have not seen, appears from the accounts to be closely related to *ringens*, perhaps a subspecies thereof. The original description and figure are inaccessible to me, and de Folin's woodcut is obviously too crude to be worth reproduction here.

Var. *garumnica* Fagot. Shell larger, less acuminate, with the upper palatal plica longer and prominent. This variety, which seems characteristic of the Garonne valley, appears at Luchon and lives from there to Montpezat on the left bank of the Garonne. On the right bank it attains nearly to the limit of the Eocene at Mauran. It is often found in the debris of the Garonne at Toulouse (*Fagot*). Westerlund adds that the peristome is more expanded than in *baillensi*, and the parietal wall more strongly plicate. Length 6½, diam. 2¾ mm.

Series of A. affinis.

Rather small and *slender* forms, much like the *braunii* group in apertural structure. Pyrenean center.

Caziot and Margier's groups of *pyrenearia* and *affinis*, Westerlund's groups 4, 5, 6, contain species of the eastern Pyrenees, chiefly in the dép. Pyrénées-Orientales in France, and

Catalonia in Spain. The group is prolific in species or local races, but few of them have been figured, and no general revision which inspires confidence has been published.

11. ABIDA AFFINIS (Rossmaessler). Pl. 44, figs. 5, 6.

Shell having an oblique rimation close behind the columellar lip, cylindric, tapering above and below, horn-brown, with hair-like striæ and therefore a satiny luster, thin, translucent. Whorls 11, rather convex, very slowly increasing, the last 4 of almost equal height, the last twice the height of the penult; suture somewhat impressed. Aperture almost ovate, higher than wide, peristome discontinuous, but little reflected, white-lipped, weakly angular below; columellar margin rather straight, shorter than the somewhat inwardly bent outer margin. On the parietal wall close to the outer margin there is a long, entering fold, doubled in front by a little fold close to it. Columella with 2 indistinct folds; in the palate two very long folds, reaching from the peristome deep into the throat, one or two quite small folds standing above the inner end; below the two long folds in front may be seen a short fold, then interrupted, and appearing again farther back; so that upon the neck one may see two long white streaks in the middle, and backward, above these, one or two short streaks, and below them one short fold in front and one behind. Length 4⅔, diam. 1¼ lines (*Rossmaessler*).

Some of my examples have the two long palatal folds interrupted, and the two lower folds concrescent into one long fold (*Rossm.*).

France: Pyrénées-Orientales at la Preste, etc.; confined to the upper Tech valley; Andorra. Catalonia: valley of Ribas at Santa Magdalena (Bofill); Pingsacas, Salt de Sallent (de Chia) Basagoda and Camprodon (Dr. Salvana), Montserrat, and de Parramon, a variety (Bofill).

Pupa affinis ROSSMAESSLER, Iconogr., ii, pt. ix, Sept. 1839, p. 26, pl. 49, f. 642.—BOFILL, Bull. Soc. Mal. France, vii, 1890, p. 253.—WESTERLUND, Fauna, 1887, p. 114, with var. *sæva*, p. 115; Synopsis, 1897, p. 83.—CAZIOT, Ann. Soc. Linn. de Lyon, Année, 1916, p. 58.—MOQ.-TAND., Moll. Fr., p. 379, pl. 27, f.

15-17; with var. *cylindrella*, fig. 18, and var. *polyodon*, fig. 19. —*Pupa longurio* Moq.-Tand., Mém. Acad. Sci. Toulouse, Nov. 1839, *teste* Moquin-Tandon.

Pupa eudolicha Bourguignat, Moll. nouv., litig ou peu con., iii, 1863, p. 74, pl. 8, f. 6-10.—Dupuy, Bull. Soc. d'Hist. Nat. Toulouse, xiii, 1879, p. 53 (as an "accidental variety" of *affinis*).—Margier, Feuille Jeunes Naturalistes, 1913, p. 198. —*Pupa "endochila* Bourg.," Germain, Encycl. Sci., Moll. de la France, ii, 1913, p. 174.

[*Pupa*] *bipalatalis* Westerlund, Nachrbl. D. M. Ges., 1883, p. 173. Synopsis, 1897, p. 93.

To Rossmässler's account may be added that there is a small spiral lamella within, past the dorsal position, and very widely separated from the rather long angular lamella. The parietal lamella is rather well developed, in a dorsal position, so deep within that it does not show in a front view, though its anterior end is visible in an oblique view in the mouth. In fig. 6 the inner end of the parietal is seen below the spiral lamella, on the right. The little supra-angular lamella is often indistinct, replaced by a callous. Upper and lower palatal plicæ and basal plica emerge to the inner edge of the lip callous, but the upper palatal is longest, curving upward into the peristome. The basal, or all, may be interrupted within, but reappear as stout teeth at the inner barrier, which is nearly a half whorl in. The suprapalatal is also stout but short, and the sutural plica is very small. The two columellar lamellæ are almost or quite immersed. Length 10, diam. 2.4 mm., or somewhat smaller.

Rossmaessler's figures are copied in fig. 5.

Var. *cylindrella* Moq. Shell a little more cylindric. La Preste.

Var. *elongata* Moq. Shell longer, and especially more cylindric, with 13 or 14 whorls. Prats-de-Mollo.

Pupa eudolicha Bgt., from La Preste (Pyrénées-Orientales) is said by M. l'abbe Dupuy, and later by M. Margier, to be without any doubt an abnormal shell of *P. affinis* in which the palatal plicæ are not developed outwardly. Such specimens occur as great rarities, Dr. Massot stating that in several thou-

sand *affinis* which had passed under his lens he found but three of this form, which may be termed a toothless variety of *affinis*.

Var.(?) *bipalatalis* Westerl. Shell cylindric-fusiform, brown, obliquely densely striate. Whorls 11, a little convex, the last compressed at base, suture impressed. Aperture vertical, narrow, oblong; two remote, short palatal plicæ; peristome not thickened within, without any vestige of a parietal callous; outer margin acute, slightly arcuate above, the columellar margin obliquely vertical, widely reflected. Length 11½, diam. 2⅔ mm. Luchon, Pyrenees. Based upon one specimen.

Var. *sæva* Westerl. Brown, indistinctly, obliquely ribstriate. Whorls 11, the first convex. Aperture pyriform-triangular, sharply angular below, with 7 lamellæ and folds: two on the parietal wall, the angular strong; 2 columellar lamellæ; 3 very long palatals, nearly interrupted in the middle, the first marginal. Margins wholly separated, the columellar margin obliquely straightened, broadly reflected above; outer margin strongly arcuate above. Length 13, diam. 3 mm. Luchon, France. (*Westerl.*)

A. affinis freseriana (Bofill). Shell rimate, cylindric, slightly inflated in the middle, tapering towards both ends, glossy, subtranslucent, fulvous, obliquely and rather regularly striate, the striæ conspicuous, not close; apex smooth, rather obtuse; 10-11 whorls, the first convex, the rest rather flattened, regularly increasing, separated by an impressed suture, the last contracted, strongly ascending above to the aperture, having four transverse white bands, crested beneath around the umbilical crevice. Aperture rather oblique, subovate, almost elongated and narrow, plicate, one bifid angular, one internal parietal, two columellars, also internal, the upper one stronger; four palatals, the first (posterior) far within, the second strong, external, third less emerging, fourth (anterior) a little immersed; all reaching into the throat. Peristome white, a little reflected, the outer lip angular above; margins approaching, joined by a thin callous. Length 9-10, diam, 2⅓–2⅔, length of aperture 2⅓–2½, width 1⅓–2 mm. Right bank of the Freser, vallée de Ribas, Pyrenees of Prov. Gerona, Spain, at the "pont del Serrat" (*Bofill*).

Pupa affinis var. *major* Bofill, Mol. del valle de Ribas, Cataluña; re-named *Pupa freseriana* Bofill, Bull. Soc. Mal. Fr., vii, 1890, p. 255.

This *Pupa* is distinguished from *affinis* by the more ventricose form, swollen in the middle; by the more ascending last whorl, which is more contracted and more projecting from left to right, giving the aperture an inclination in the same direction; by the narrower, more lengthened aperture, by the different rate of increase of the whorls, the more regular striation, the fawn, not reddish color, etc. (*Bofill*).

A. affinis perlonga Bofill. Shell subperforate-rimate, slender, cylindric, tapering towards both ends, glossy, subtranslucent, corneous-rufescent, the apex a little obtuse, smooth; obliquely, irregularly striate, the striæ silky, hair-like, bent. 13–15 whorls, a little convex, rather rapidly increasing, oblique, separated by a deep suture, the last irregularly rugose, somewhat ascending to the aperture, having 4 pale transverse bands, acutely crested at the rimation. Aperture vertical, rather narrowly subelliptical, plicate: folds as in *P. freseriana* but stronger, the parietal and columellar less deep within. Peristome pale, reflected, the lip angular, margins subparallel, little approaching, joined by a thin callous. Length 13, diam. 3, aperture 3 mm. long, 2 wide. Right bank of the Freser at "Den Montagut," 5 kilom. below Ribas, Prov. Gerona, Spain, at about 700 meters elevation (*Bofill*).

Pupa affinis var. *elongatissima* Bofill, Mol. del valle de Ribas, Cataluña; re-named *Pupa perlonga* Bofill, Bull. Soc. Malac. France, vii, 1890, p. 257.

Pupa affinis of la Preste passes by insensible gradations, still preserving its specific characters, from the type figured by Rossmaessler to the var. *elongata* Moq.-Tand. and the var. *elongatissima* of the abbé Dupuy, without however merging with our *P. perlonga* (*Bofill*). The latter was found rather rare, in company with *P. catalonica*.

12. Abida phthisica (Bofill).

Shell rimate, subcylindric, slender, rather solid, tapering above, contracting in the last whorl, glossy, corneous-fulvous, obliquely and rather closely striate, the apex smooth, obtuse. Whorls 11-12, a little convex, slowly and regularly increasing, separated by an impressed suture, the last whorl exserted, strongly ascending to the aperture, whitish, having four pale

transverse bands, crested at the rimation. Aperture rather wide, somewhat oblique, rounded subovate, conspicuously plicate, the plicæ as in the preceding species, strong. Peristome rather thick, subeffuse, margins approaching, joined by a callous which is not thin. Length 10, diam. 2⅓–2½ mm., aperture 2 mm long, 1⅔–2 wide.

Spain: Besora in prov. Barcelona, alt. about 600 meters (*Bofill*).

Pupa phthisica BOFILL, Bull. Soc. Malac. Fr., vii, 1890, p. 258.

This is the best characterized species, recognizable at first sight by the quite solid spire, very slender, acicular, tapering progressively towards the summit, the penult whorl constricted, in this respect resembling *P. vergnesiana* KÜSTER as figured by Bourguignat (Rev. et Mag. de Zool., 1863, p. 155, pl. 14, f. 20); by having the aperture produced, as in certain Cylindrellas, etc. (*Bofill*).

13. ABIDA VERGNIESIANA (Charp., Kuester). Pl. 44, figs. 7, 10, 12.

Shell rimate, subperforate, cylindric, closely and finely costulate-striate, silky, corneous-brown; spire long, rather obtuse. Whorls 9, convex, narrow, the last compressed basally, free in front. Aperture rounded-oblong, contracted; one angular fold, one deeply placed parietal, two columellar, and three palatal, the lower basal, smaller. *Peristome free, continuous*, white-lipped, a little expanded. Length 3, diam. ¾ line (*Kuester*).

France: Pyrenees, valley of the Ariége and its tributaries, at Vic-Dessos; also found at Tarascon (Ariége) and Foix (Charpentier). San Julia de Loria (*Bourguignat*).

Pupa vergniesiana Charp. in litt., KUESTER, Syst. Conchyl. Cab., *Pupa*, p. 103, pl. 14, f. 13-16.—PFR., Monogr., iii, p. 547; iv, 673; vi, 314; viii, 383.—BOURG., Rev. et Mag. de Zool., xv, 1863, p. 155, pl. 14, f. 20-22.—*Pupa transitus* BOUBEE, in part, Bull. Hist. Nat., 2d edit., 1833, p. 9 (*teste* Pfr.); *Pupa transiens* Boubée (*teste* West.).—*Pupa pyrenaearia* PFR., Monogr., ii, p. 342.

The aperture has a distinct sinulus, the lip retracted there. The angular lamella is calloused on the right at its junction with the lip. There is no spiral lamella. The strong parietal lamella enters to a dorsal position. Columellar and subcolumellar lamella are short, remote from the lip; the former is steeply oblique. The upper palatal plica emerges into the peristome, which the lower palatal barely reaches. Both become weak deep within, and in the back are emphasized, forming strong teeth. The basal plica is small and slender, interrupted within, but represented by a tubercle below the palatal teeth of the inner barrier. Beyond the inner barrier the palatal plicæ extend very weakly, so that they are visible on the outside in a lateral view of the left side of the shell. Length 6.4, diam. 2 mm.; 8½ whorls, or a little longer.

Bourguignat's figures represent the aperture as larger than in those of Kuester (copied in pl. 44, fig. 12), or the specimens I have seen, figured in pl. 44, figs. 7, 10.

I have not seen Boubée's *Bulletin*, in which this form (or an allied one, according to Bourguignat) was described as *Pupa transitus* or *transiens*.

A. vergnesiana provida Westerlund. Pl. 44, fig. 11.

Aperture with the upper columellar tooth of moderate size, deeply placed, the lower very small or obsolete; 2d and 3d palatal teeth produced inward only half as far (*duplo brevius*) as in the type. Pyrenees (*West.*).

P. (*Torquilla* Faure-Big.) *vergniesiana* (Ch.) var. *provida* Westerlund, Nachrbl., 1902, p. 39.

I take this to be a form in which the palatal plicæ only reach the dorsal side weakly, without a distinct inner barrier, such as the specimen (from Terver) drawn in pl. 44, fig. 11.

14. Abida pyrenæaria (Michaud). Pl. 44, fig. 9.

Shell oblong, nearly cylindric, umbilicus quite open, fawn-colored, glossy, a little transparent, with oblique, longitudinal striæ; 9 whorls, a little convex; aperture rounded, contracted, and armed with 5 or 6 folds; peristome white, reflected, nearly margined and continuous, the lateral margin elbowed or in-

flected; columella [i. e., parietal wall] callous by the continuation of the peristome which covers it, one-folded; summit obtuse. The first four whorls increase progressively, the others are nearly equal except the last, which terminates in a contraction. Height 3 lines, diam. 1 line. It is distinct [from *P. granum* and *secale*] by the arrangement of the folds, the contraction of the aperture and the continuation of the peristome, which has 6 or 7 folds, counting that of the columella (*Michaud*).

France: Pyrénées-Orientales. Spain: Port de Salau (Noguera Polloresa) at 1,800 meters, Catalonian Pyrenees (Bofill).

Pupa pyrenæaria MICHAUD, Complément, etc., 1831, p. 66, pl. 15, f. 37, 38.—PFR., Monogr., iii, 547, in part.—MOQUIN-TANDON, Moll. France, p. 364.—WESTERLUND, Fauna, iii, 1887, p. 112.—BOFILL, Bull. Soc. Malac. France, vii, p. 266.—CAZIOT, Ann. Soc. Linn. Lyon, Année, 1916, p. 57 (distribution).—*Pupa pyrenearia* of some authors.—*Pupa "pyrenaica* Boubée" GERMAIN, Encycl. Sci.: Moll. de la France, ii, 1913, pp. 173, 175, f. 227.

The figures are copied from Dupuy.

According to Caziot, "the *Pupa pyrenæaria* extends, in various forms (which have been made, I think erroneously, into species), far to the east, and even penetrates to the Mediterranean region. Thus, *P. vergnesiana* (Ch.) Kstr. and *P. aulusensis* Fag. are found in the valley of Salat. In the valley of the Ariège and its affluents, also the *P. vergnesiana*. In the valley of the Aude, *P. leptospira* West. In the valley of the Agly and on Mt. Alaric, *P. attenuata* Fag."

Var. *novemplicata* Moquin-Tandon. Shell of the same size [6-8 mm.]; aperture with 9 folds (two little accessory folds between the palatals). Cazeril.

Var. *curta* M.-T. Shell shorter by a quarter or third; aperture with the same folds, but less marked.

Abida pyrenæaria clausilioides (Boubée).

Shell scarcely perforate, fusiform-cylindric, corneous-rufous, somewhat glossy, pellucid, striatulate, the striæ low, oblique, very close; spire long, slightly tapering, the apex very

obtuse. Whorls 10, the first a little convex, the rest nearly flat, suture not impressed, the last whorl larger, compressed, ascending to the aperture, and somewhat crested around the umbilicus. Aperture not oblique, irregularly oblong, seven-toothed: two parietal folds, one being nearly in the angle, strong, bified and reaching the margin, the other minute, deeply placed. Two compressed columellar folds, very deep in the throat. Three slender palatal folds, the lower remote and short, sometimes wanting, the median somewhat remote, the upper one almost marginal. Peristome a little thickened, continuous, free, reflected throughout, white. Length 8, diam. 3 mm. (*Fagot*).

Hautes-Pyrénées: Mauléon en Barousse (Fagot).

Pupa clausilioides Boubée, Bull. Hist. Nat., Apr. 1, 1835, p. 35, no. 81 (not seen).—Fagot, Bull. Soc. d'Hist. Nat. Toulouse, xiv, pp. 205-208. — *Pupa pyrenearia* var. *boubeensis* Fagot et Nansouty, Moll. Haute-Cyr. (Bull. Soc. Ramond.), 1875, p. 20.

According to Fagot, this shell is more fusiform than *P. affinis*, more compressed above, more thick-set, more cylindric, and with the apex more obtuse; its aperture is *continuous*, detached and reflected; the columellar folds are more immersed, etc. It is larger than *P. vergniesiana*, more finely striate, the aperture straight, not inclined, and a little detached from the preceding whorl; its palatal folds are thinner, etc. It is more fusiform than *P. pyrenæaria*, the last whorl more compressed, striæ lower, and the whorls less swollen, not to mention its length, etc.

M. Fagot holds that the identifications of this species by Dupuy, Pfeiffer and Westerlund are incorrect; and as I am not in a position to decide, and the original publication of Boubee is not accessible to me, his definition is given above.

The descriptions of several other related forms of unsettled status follow.

15. Abida nansoutyi P. Fagot.

Shell thinner than *P. pyrenæaria*, more cylindric, thicker at the summit, the umbilical perforation rounded, as in *P.*

secale, the peristome thinner, not continuous, and the folds are more delicate and differently arranged, 7 x 2 mm. Station Plantade on the Pic du Midi de Bigorre (de Nansouty). *Pupa nansoutyi* Fagot, Bull. Soc. d'Hist. Nat. de Toulouse, xiv, 1880, p. 205. *P. nansoutyana* Fag., in Journ. de Conchyl., xxix, 87.

16. ABIDA RETRACTA (West.).

Shell perforate, cylindric-conic, very densely striatulate, pale corneous. Whorls 8, convex, slowly and regularly increasing, separated by an impressed suture, rather oblique below, the last whorl slowly ascending in front, angular above, rounded basally. Aperture ovate-elliptical; one immersed, curved parietal fold, two very short, deeply immersed columellar folds, the second scarcely visible; four immersed, parallel, palatal plicæ, subequal in front, the first and fourth very short, third rather long. There is also a small tubercle at the insertion of the outer lip. Peristome a little expanded, the margins subparallel, the outer margin curved in an obtuse angle above. Length 6, width 2 mm. Related to *P. nansoutyi* Fag. (*Pupa (Torquilla) retracta Westerlund*, Nachrbl. d. M. Ges., 1892, p. 194; Anales de la Soc. Española de Hist. Nat. (2), i, 1892, p. 388.)

Spain: Seville, in debris of the Guadalquivir (Prof. Calderon).

Var. *semidens* West. Shell more strongly and regularly striate; whorls 7, aperture with 4 long palatal plicæ equally distant from the margin, the first, second and fourth very short, thick, third a little longer, all tapering in short plicæ. Albarracin, Spain; B. Zapater. *Pupa (Torquilla) retracta* West. var. *semidens* WESTERLUND, Nachrbl., 1893, p. 120; Synopsis, p. 86.)

17. ABIDA AULUSENSIS (Fagot).

Shell minutely perforate-rimate, *cylindric with rounded apex*, reddish horn-color, lusterless, quite transparent, regularly, obliquely striate, the last two whorls *almost smooth*. Whorls 9½–10, quite flattened, slowly and regularly increas-

ing, the last *strongly compressed beneath*. Aperture irregularly oblong-rounded, vertical, with 7 lamellæ and folds: 2 parietal; 2 columellar, strong and very deeply placed; 3 palatal folds, the first marginal, interrupted in the middle, second strong, somewhat retreating, third small, immersed. Peristome *thick, continuous*, reflected throughout, weakly connected. Length 9, diam. 2½–2¾ mm. (*West.*).

France: Ariège. Also Spanish slope of the Pyrenees at Port de Salau, 1800 or 2000 meters elevation (Bofill).

Pupa aulusensis Fagot, Moll. terr. et d'eau douce, vallée d'Aulus, Bull. Soc. Agric. Pyr.-Or., 1879, p. 23, fig. 1; Annales de Malac., ii, p. 189.—Bofill, Bull. Soc. Malac. France, vii, 1890, p. 266.—Westerlund, Fauna, iii, 1887, p. 113.

Not having seen Fagot's paper, the description is taken from Westerlund.

18. Abida occidentalis ('Fagot' Westerl.).

Shell narrowly perforate-rimate, elongate, oblong-conic or cylindroid-fusiform, slowly tapering almost from the last whorl, very densely and regularly striate, corneous-brown. Whorls 9–9½, convex, slowly and regularly increasing, the last compressed below, slowly ascending above. Aperture oval-rotund; angular and parietal folds short and strong, neither marginal; columellar lamellæ 2 (the first immersed, strong, the second smaller, very deeply placed, scarcely visible); palatal laminæ 4 (first small, immersed, second and third marginal, fourth short, basal), all produced equally to the middle of the last whorl. Peristome continuous, white, free and produced. Length 7, width 2.33 mm. (*Pupa (Torquilla) occidentalis Westerlund*, Verh. zool.-bot. Ges. Wien, xlii, 1892, p. 37).

France: Valle Gave de Pau (Hautes-Pyrénées). Also a *Pupa affinis* form, or belonging to the division containing *Pupa pyrenæaria* (Boub.) Mich. (with *P. aulusensis* Fag., *P. attenuata* Fag., *P. vergniesiana* (Ch.) Kstr. and *P. clausilioides* Boub.) (*West.*).

19. Abida petrophila (Fagot). Pl. 44, fig. 13.

It differs from *pyrenæaria* (1) by the less prominent and more spaced costulæ; (2) by the last whorl more contracted

at the base, as in the species of the *affinis* subgroup; (3) by having the lip-margins not united but separated; (4) and especially by its dentition; all of the lamellæ are prominent and robust, the upper columellar emerges to the peristome; the columellar lamellæ and the median parietal are exactly opposed to the palatals, instead of alternating as in *P. pyrenæaria* (it is the same with *cereana* in comparison with *avenacea*); this gives the aperture the appearance of being obstructed by the nearly touching lamellæ. The angular lamella is often double. Finally, one or two supplementary punctiform palatals may be seen between the upper palatal and the suture; characters very well indicated by Kuester's figure (*Fagot*).

France: Pyrénées-Orientales. Villefranche du Confluent; footpath of San Julia de Loria at Andorra, on the Spanish slope of the Pyrenees (*Fagot*).

Pupa pyrenæaria (*varietät*), received as *Pupa saxicola* Moquin-Tandon, KUESTER, Syst. Conchyl. Cab., *Pupa*, p. 104, pl. 14, f. 29-31. Not *Pupa saxicola* Lowe, 1852.—*Pupa petrophila* FAGOT, Catal. Esera., 1888.—Bofill, Bull. Soc. Malac. France, vii, 1890, p. 260.

According to Fagot, this shell was first found by Professor Al. Braun in the environs of Prades at Villafranche sur la Têt (Pyrénées-Orientales), who communicated specimens to Professor Moquin-Tandon. Some were sent, with the Ms. name *Pupa saxicola* M.-T., to Charpentier, and were figured by Kuester.

Fagot has given an incorrect reference to Kuester, but his meaning is evident. He considers *P. pyrenæaria* var. *saxicola* of Moquin-Tandon's Moll. de France different.

20. ABIDA BOFILLI Fagot. Having the external appearance of a small *Pupa affinis*, this new species is related by its teeth to *P. aulusensis*. *P. bofilli* is easily separable from *pyrenæaria* and the related species by having the peristome not continuous, the shell lengthened-fusiform, etc. Length 8, diam. 2 mm. (*Fagot*). Related to *petrophila*, from which it differs by the more delicate striations which give the shell greater brilliance; by the less large aperture, and the less robust apertural lamellæ, which are arranged nearly the same. On rocks

around the monastery of Montserrat, type loc., prov. of Barcelona, and has been found also at Cardona (*Bofill*). (*Pupa bofilli* Fagot, Contrib. à la Faune malac. de la Catalogne, in Annales Malacol., ii, 1884, p. 189. — Bofill, Bull. Soc. Malac. Fr., vii, p. 262.)

21. ABIDA LILIETENSIS (Bofill). Differs from *P. bofilli* by the nearly obsolete striations, giving it a varnished appearance; by the more oblong aperture, its lamellæ more delicate, though longer. It differs from *andorrensis* by the more slender form, the coloration of a lighter fawn, by the sinuation of the right margin, the peculiar parietal, the long upper columellar, etc. Length 8-9, diam. 2 mm., 10-11 whorls. Catalonian Pyrenees two or three kilometers above Pobla de Lillet, on the road of Castella de Nuch, banks of the Llobregat. (*Pupa l.*, Bofill, Bull. Soc. Malac. Fr., iii, 1886, p. 155; vii, 1890, p. 263.)

22. ABIDA MONTSICCANA (Bofill). A slender form of 13-14 whorls, which are obliquely wrinkled instead of regularly striate as in other species of the group; base conspicuously crested. The columellar and palatal teeth where largest almost touch, leaving a very narrow exit for the animal. Length 9–12½, diam. 2½–3 mm.

Catalonian Pyrenees, on small plants and limestone rocks of "Portell del Montsedi" near the Pas del Roure (Noguera Ribagorzana) at an elevation of about 700 meters.

Pupa montsiccana BOFILL, Bull. Soc. Malac. Fr., vii, 1890, p. 263.

23. ABIDA ANDORRENSIS (Bourg.). Pl. 44, figs. 14, 15.

Shell perforate-rimate, cylindric, glossy, obliquely very sharply striate, rufous-corneous. Spire elongate, tapering, the apex minute, smooth, corneous, somewhat obtuse. Whorls 10, a little convex, regularly increasing, separated by an impressed suture, the last whorl ascending at the aperture, and compressed-carinate at the base. Aperture rounded, multidentate; 2 angular lamellæ, one very small, the other longer and strong; 2 little folds on the parietal wall, and 2 deeply placed parietal lamellæ; 3 columellar lamellæ, the lowest minute, between them are often some little folds outwardly; 5 palatal plicæ, the lower one very minute, the upper small, immersed, scarcely to be seen, and three strong, emerging

folds in the middle. Peristome whitish, thickened, expanded, nearly continuous, with the margins approaching and joined by a callous. Length 10, diam. 3 mm. (*Bgt.*).

Catalonian Pyrenees: San Julia de Loria, in crevices of rocks along the road (*Bourg.*).

Pupa andorrensis BOURGUIGNAT, Revue et Mag. de Zool. (2), xv, 1863, p. 155, pl. 14, f. 17-19.—PFR., Monogr., vi, 312.—WESTERLUND, Fauna, iii, p. 116.

Bourguignat notes that it differs from *P. polyodon* by the longer, fusiform and not ventricose shell, the deeper umbilical crevice and larger perforation; by the compression of the base of the last whorl, where there is a projecting ridge nearly as acute as in *P. goniostoma;* finally by the different and less numerous apertural teeth.

24. ABIDA CATALONICA (Bofill). Palatal plicæ long, as in *P. affinis*, but possessing a stronger parietal, and especially two subhorizontal columellars, of which the upper one emerges to the peristome. Length 11, diam. 2½.

Spain: Camprodon, in the Pyrenees of prov. Gerona; also at "Den Montegut," Ribas valley; Olote (Bofill).

Pupa catalonica BOFILL, Bull. Soc. Malac. France, iii, 1886, p. 157; vii, 1890, p. 259.

25. ABIDA HETAERA (West.). Shell perforate-rimate, cylindric, at the apex conic, densely and regularly, delicately but sharply striate, more distinctly and strongly so on the last whorl; fulvous-corneous. Whorls 10, very slightly convex, regularly increasing. Aperture oval, margins not connected or but very delicately so. Angular fold doubled in front, one parietal fold slighter, immersed; two columellar lamellæ (the first very long, submarginal, the second shorter, not marginal); four palatal laminæ (first very deeply placed, second and third very long, submarginal, penetrating inward to the columellar margin, as seen in a front view, fourth wholly basal; the second and third opposite the columellar lamella and parietal plica); sometimes having a tubercle in the angle between columella and parietal wall. Length 8, diam. 2.33 mm. (*Pupa (Torquilla) hetaera Westerlund*, Verh. zool.-bot. Ges. Wien, xlii, 1892, p. 36.)

East Pyrenees. This remarkable *Pupa affinis* form is especi-

ally related to *Pupa lilietensis* Bof., of Catalonia, from which it differs principally by its apertural armature, diverse in number, form and position (*West.*).

26. ABIDA LEPTOSPIRA (West.). Shell *slender, cylindric-turrited*, very slowly tapering above, with obtuse apex, very closely, beautifully striate with hair-fine striæ, with a matt satin luster, dark horn-yellow, thickened and broadly white near the aperture. Whorls 9½–11, *convex*, slowly increasing, the last ascending, contracted behind the peristome, bluntly carinate below. Suture impressed. Aperture elliptic-rounded, with 8 lamellæ and plicæ: 2 parietal lamellæ, the upper one minutely doubled; columellar lamellæ 2, the upper *very long, emerging quite to the margin*, the second shorter; palatal plicæ 4, the first very short, immersed, the rest penetrating only to the middle of the whorl; second and third marginal, very weakly S-shaped. Peristome *continuous*, the connecting callous *thick, white*, very narrowly reflected throughout, lipped. Length 7½–8, diam. 2 mm. (*Pupa leptospira Westerlund*, Fauna, iii, 1887, p. 113, no. 79.) France: Axat (Aude), *Fagot*.

27. ABIDA MIGMA (West.). Shell openly, roundly perforate, cylindric-conic (gently narrowed conically from the middle up, the sides a little convex), delicately, densely and elegantly striate, corneous. Whorls 9½, slowly and regularly increasing, the upper more strongly, lower more slightly convex, the last crested-compressed at the base. Aperture oval, the peristome continued as an acute, elevated callous. Angular fold furnished with a tubercle in the angle; parietal fold immersed; columellar lamellæ 2, the first submarginal, second shorter; 3 long marginal palatal laminæ, the first and second penetrating inward to above the perforation, somewhat abrupt at the beginning, then strong at the end; the third basal. Length 8, width 2 mm. (*Pupa migma Westerlund*, Verh. zool.-bot. Ges. Wien, xlii, 1892, p. 37.)

France, in the eastern Pyrenees. It shares the last division of the *Pupa affinis* group with *P. leptospira*, and differs from that by the open perforation; the shape, which is cylindric below, conic above the middle; the weakly convex later whorls; the palatal plicæ being only three in number but much more deeply penetrating, at first broken off, the strong, sharp (not thickened) parietal callous of the peristome, etc. (*West.*).

28. ABIDA ATTENUATA (Fagot). This species, which will be

characterized later, belongs to the group of *Pupa pyrenearia*, but is easily distinguished from its congeners by the spire, which regularly tapers from aperture to summit, a little like *P. affinis* (Rossm.) and our *P. bofilliana*. *Pupa attenuata* is abundant in the valleys of the Aude and the Agly, where it replaces *P. vergnesiana* of Ariège. Banks of the Agly a little above l'Ermitage, in the ravine (*Pupa attenuata* Fagot, Bull. Soc. Malac. France, iii, 1886, p. 202).

This form was described more in detail by Westerlund from specimens supplied by Fagot. "Similar to *leptospira*, but *conic-turrite*, gradually and regularly tapering from the aperture upward, horn-brown; whorls 9, the six upper very slowly increasing, *the three lower much broader, but of about equal width;* the uppermost three cylindric, the rest convex, the last whorl rapidly sloping behind. Angular lamella *very long;* columellar lamella *deep within;* peristome *thin*. Length 7, diam. 2 mm." (*Westerlund*, Fauna, iii, 1887, p. 114.)

29. ABIDA OPAREA 'Bgt.' Loc. Narrowly elongate, Clausiliform, tapering slowly at the base and summit; 9-10 quite convex whorls, a little high, especially the last, the suture quite impressed. Aperture subtriangular, quite angular at the base, contracted above; 2 thin superior folds, one lodged at the suture, the other immersed; 2 immersed columellars, the first stronger, situated in the superior angle; 3 palatals, only the first attaining the margin, the last very small. Peristome subcontinuous, thin, slightly everted. Shell red-brown, ornamented with very fine striæ, crowded, a little irregular. Alt. 10, diam. 2½ mm. Very rare; le Tourmalet, Saint-Sauveur (Hautes-Pyrénées). *Pupa oparea* Brgt. in coll., Locard, Ann. Soc. de l'Agricult. Lyon (7), iii, 1896, p. 205. Placed by M. Locard in the group of *micheli*.

Series of A. frumentum.

Cylindric, having four long palatal plicæ, an interpalatal being developed; also a short, immersed suprapalatal or sutural plica. Chiefly developed in the eastern and southern Alps, but *A. frumentum* spreads far into Austria, Germany and France.

a^1. A distinct twin lamella accessory to the angular lamella, at the upper angle of the lip.

b^1. Accessory lamella rather long. *A. apennina*, no. 32.

b^2. Accessory lamella short; no whitish callous swelling behind the outer lip. *A. illyrica*, no. 31.

a^2. No accessory lamella in the upper angle, the angular lamella being thickened there; usually a whitish callous behind the outer lip. *A. frumentum*, no. 30.

30. ABIDA FRUMENTUM (Drap.). Pl. 42, figs. 1 to 4.

Shell cylindric, the upper third conic; somewhat transparent tawny-olive, with an opaque whitish more or less swollen tract behind the lip; rather closely regularly striate. Angular lamella strongly thickened on the right side where it joins the peristome, a short, deeply placed lamella (spiral lamella) beyond its inner end. Columellar and subcolumellar lamellæ subequal, remote from the peristome; the supracolumellar small and almost immersed or wanting. There are 4 long, conspicuous plicæ, the lower palatal slightly longest and penetrating to the mid-dorsal line; upper palatal nearly or quite as long; the interpalatal and basal plicæ are shorter within; deep within a short suprapalatal or sutural plica may be seen; all of them are conspicuous externally as light lines. Lip is reflected, thickened and whitish, preceded by a low crest or hump.

Length 7.7, diam. above aperture 3 mm.; 9 whorls (Lyons).

France, mainly north and east, Alsace to Bohemia, south to Servia, Dalmatia, northern Italy; Sardinia and Corsica.

Pupa frumentum DRAPARNAUD, Tableau, etc., 1801, p. 59; Hist. Nat. Moll. France, p. 65, pl. 3, f. 51, 52.—ROSSMAESSLER, Iconogr., i, p. 81, f. 34; pt. v, p. 11, f. 310.—PFEIFFER, Monogr., ii, p. 338; iii, 546; iv, 672; vi, 312; viii, 382 (see for older references).—SCHMIDT, Stylommatophoren, p. 42, pl. 10, f. 81 (anatomy).—KÜSTER, 9ter Ber. Ges. nat. Bamberg, 1870, p. 95 (Dalmatian forms and dist.).—BOETTGER, Jahrb. Nassau. Ver. Naturk., xlii, 1889, p. 247 (distribution).—WESTERLUND, Fauna, iii, 1887, p. 107, with varr. *elongata, illyrica, curta, cylindracea, pachygastra, apennina, polita, bugeysiaca* and *minor*.—CAZIOT, Bull. Soc. Zool. France, xxxv, 1910, pp. 155-159.—*Pupa frumentum* (southern Tirol, Trient) and var. *castanea* GREDLER, Nachrbl., xi, 1879, p. 110.—*Pupa frumentum* Drap., with varr. *subcylindrica, ventricosa* and *bugeysiaca* LOCARD, Études variations Malacologiques, i, 1880, pp.

256-7.—*Pupa triticea* Ziegler, "*frumentacea* Drap.," *rhodanica* Loc., *rustica* Bourguignat Ms., LOCARD, Annales Soc. d'Agriculture, Sci. et Ind. de Lyon (7), iii, for 1895 (1896), p. 192, and *Pupa crimoda, mea* and *nova* Bgt. Ms., p. 193; iv, 1897, p. 83.—*Pupa callosa* Ziegler MS., ROSSMAESSLER, Iconogr., i, 1835, p. 82, as synonym of typical *P. frumentum.*

The typical *P. frumentum* of France, Belgium and southern Germany is characterized by the whitish, usually swollen tract behind the lip (or so-called cervical callous of some authors); the angular lamella with a callous enlargement where it joins the lip, but no entering lamella between the angular and the outer lip; a small, short, remote "spiral lamella," visible with difficulty inward from the angular lamella, and a rather small, regularly striate shell. This type is somewhat modified in northern Italy and eastward, but as yet there has been no careful comparative study of these minor modifications. The more distinct forms of northern Italy and Illyria have been segregated as species (*illyrica* and *apennina*).

The southern border of the range of *frumentum* in Italy has not been definitely stated, but it is not known from Sicily except by two empty drifted specimens found on the strand.

The following forms defined by Locard are either synonyms or local races of *frumentum.*

Pupa rhodanica Loc. Small, ovoid, short and very squat, rapidly tapering above; 7-8 convex whorls, the suture well marked. Aperture relatively large, somewhat rounded, with well-developed folds; 2 straight, contiguous superiors, the largest at the suture, the other immersed; 2 subequal columellars, contiguous and immersed; 4 palatals attaining the peristome, the third larger than the others. Peristome a little reflected, thick. Shell corneous-red, ornamented with fine and regular striæ. Alt. 6-7, diam. 3 mm. Quite rare; Rhone, Ain, Isère, Savoie, etc. *Pupa rhodanica* Locard, Ann. Soc. d'Agricult. Lyon (7), iii, 1896, p. 192.

Pupa rustica Bgt. Loc. Small, cylindroid, a little narrowly elongated, slowly tapering above; 7-8 convex whorls, the suture well marked. Aperture nearly rounded, with converging margins; 2 superior folds, the longest against the suture,

straight and calloused, the smaller immersed and oblique. Two columellars, deeply immersed, small and strongly contiguous; 3 palatals, the two upper small and immersed, the third stronger and reaching the peristome. Peristome expanded, well reflected, a little thin, light corneous, ornamented with very fine, slightly effaced striæ. Alt. 7-8, diam. 2½ mm. Quite rare. Hautes-Alpes, Isère, Drome, Ain, Savoie, H.-Savoie, etc. (*Pupa rustica* Brgt. in coll., Locard, *t. c.*, 1896, p. 192.)

Pupa crimoda Bgt., Loc. Quite small, cylindroid, rather short, slowly tapering above; 9 convex whorls, the first close, the last large, the suture marked. Aperture oblique, semicircular; 2 closely contiguous superior folds, subequal, only one of them immersed and a little callous; 2 small, deeply immersed columellars; 3 palatals, the first very small, the following two reaching the margin; peristome expanded, much reflected, well thickened. Shell solid, corneous-red, finely striolate. Alt. 8½, diam. 3 mm. Very rare; Méaille near Annot (Basses-Alpes). *Pupa crimoda* Brgt. in coll., Locard, *t. c.*, p. 193.

Pupa mea Bgt., Loc. Small, conoid-ventricose, short and fat; 7 convex whorls, the suture quite well marked. Aperture semicircular, quite large, well rounded at base; 2 closely contiguous superior folds, as though superposed, straight, subequal, only one emerging to the suture; 2 quite strong, deeply immersed columellars; 3 palatals, the first two very small, the third attaining the peristome. Peristome well expanded, reflected, quite thick. Shell light corneous, a little striolate. Alt. 6, diam. 2¾ mm. Rare; Aix-les-Bains (Savoie), environs of Belley (Ain), etc. *Pupa mea* Brgt. in coll., Locard, *t. c.*, 1896, p. 193.

Pupa nova Bgt. Loc. Very small, ovoid, a little elongate, slowly tapering above; 7 quite convex whorls, the suture well impressed. Aperture small, subovate, a little retracted at base; 2 superior folds, of which one is small and immersed, the other at the suture, emerging, large and a little oblique; 2 small, deeply immersed columellars; 3 palatals, the upper two deeply immersed, scarcely visible, the third reaching the peristome. Peristome little expanded, slightly reflected, quite thin. Shell corneous-red, a little striolate. Alt. 6, diam. 2¼ mm. Very rare; Aix-les-Bains (Savoie). *Pupa nova* Brgt. in coll., Locard, *t. c.*, 1896, p. 183.

Var. *curta* (Pot. et Mich.). Pl. 46, fig. 8. This little shell,

very distinct by the numerous teeth and folds which are in the aperture, has similarity of form with *Pupa polyodon*, but it is shorter and more ventricose; the aperture is subtriangular, and the labrum, or lateral border, is ornamented with four laminæ which become lost in the cavity. Two teeth are placed on the columellar margin, and two other lamellæ cover the columella [i. e., the parietal wall]; one of these lamellæ, placed further forward, abuts on the upper angle of the aperture at the point of insertion of the lateral margin with the columellar. The whole surface is very distinctly and obliquely grooved, the grooves visible under the lens, and sometimes to the naked eye. The Tyrol. (*Pup*[*a*] *curta* Potiez et Michaud, Galerie des Moll., Donai, i, 1838, p. 164, pl. 16, f. 13-14.)

The figure shows a shell 9½ mm. long, of about 9 whorls. It does not seem to have been recognized by subsequent authors, and its position is dubious. Possibly a *Chondrina*.

Var. *subcylindrica* Locard, 7–8½ mm. long, subcylindric. Mont-d'Or lyonnais and debris of the Rhone north of Lyons.

Var. *ventricosa* Loc. Smaller than the type, shorter, more conic and more swollen at the base; special to the environs of Lyons.

Var. *bugeysiaca* Loc. Of medium size, a little ventricose, the peristome quite strongly reflected, columellar and palatal folds deeply immersed except the third palatal. Found at Thoys near Belley, department de l'Ain.

Form *intrans* Westerlund (Syn. Moll. Extramar. Reg. Pal., 1897, p. 80) has the second, third and fourth palatal plicæ prolonged inward as far as the columellar margin (as viewed from in front). Lyons. In typical *frumentum* only the third or lower palatal plica is so long.

Var. *turgida* Parr. Küster. Pl. 42, fig. 6. Very small, strongly ventricose, the folds strongly developed. Alt. 2½–3, diam. 1½ lines. In Switzerland, Carniola, in Istria near Trieste, in company with the typical form. *Pupa frumentum* var. *curta* (*Pupa turgida* Parreiss Ms.) Kuester, Conchyl. Cab., *Pupa*, p. 41, pl. 5, f. 20, 21. Probably not a valid race, as such short forms occur as individual variations in normal colonies. It is not *Pupa curta* Pot. et Mich., 1838.

Another name for the form is *P. f.* var. *minima* Kreglinger, Syst. Verz. Deutschl. Binnen-Mollusken, 1870, p. 192.

Var. *curta* Issel. Shell small, ventricose, short, with the aperture somewhat triangular. Debris of the Arno, Prov. of Pisa (Tuscany). *Pupa frumentum* var. *curta* Issel, Moll. Pisa, in Mem. Soc. Ital. Sci. Nat., ii, pt. 1, 1866, p. 21. The name had previously been used by Potiez and Michaud and by Küster for forms of *frumentum*.

Form *primula* West. Shell still more entirely cylindric, conically tapering only at the apex, whitish, pellucid, densely, regularly striatulate. Whorls 11, the upper slowly increasing, middle ones equal, the last small, subtriangular as seen from the left side, retracted below. Aperture small, the angular lamella very thin and short, parietal lamella deep, two palatal plicæ very long, the lower marginal. Length 9½, width 2 mm. Hungaria at Trencsin-Teplicz. (*Pupa* (*Torquilla*) *frumentum* Drp. var. *cylindricea* Rm. form *primula* Westerlund, Nachrbl. d. Malak. Ges., xxiv, 1892, p. 193.)

In Synops. Moll. Extramar. Reg. Pal., 1897, p. 80, Westerlund says: "palatal plicæ 4, the first deeply placed, thin, second and fourth very thin, scarcely conspicuous, third subemerging, long."

Abida frumentum hungarica (Kimakowicz). Pl. 42, fig. 5.

"Distinguished by the constantly wanting or only very weakly developed apertural callous [behind the outer lip], and the obsolete, somewhat less regular striation of the shell. In form and size it agrees with the type form. The angular lamella is always simple and at most somewhat thickened in front.

"The shells vary somewhat in shape and in the more or less distinct striation. Often, especially in the northern localities, a callous on the neck is indicated, or the lamellæ and plicæ are better developed, but in these places there are always transitions to the typical var. *hungarica*. The size varies from length 5.7, diam. 2.5 mm. to 10.3 x 3.3 mm." (*Kimakowicz*).

Transylvania, in the part southwest of a line connecting Kronstadt and Klausenburg; also on the southern slope of

the Transylvanian Alps, south of Tömöser Pass, in Rumania (*Kim.*).

Torquilla frumentum Drap. var. *hungarica* Kim., Verhandl. u. Mittheil. des Siebenbürgischen Vereins für Naturwiss. in Hermannstadt, xl, 1890, p. 102.—*Pupa frumentum*, and *P. f.* var. *illyrica* in part of Clessin and Westerlund.

In a large series from Nándor received from E. A. Bielz, the aperture is exactly as in *frumentum*, but the callous behind it is weaker or wanting, and the striation is finer. The shorter shells, about 6 mm. long, have the upper half conic; the longer ones, 8 mm., are markedly cylindric. While not strongly differentiated, it appears to be distinguishable as a peripheral southeastern race.

Abida frumentum pachygastra (Ziegl., Rossm.). Pl. 42, figs. 7, 10, 11.

Shell cylindric-fusiform, acuminate, ventricose, corneous-buff, very delicately rib-striate. Aperture semiovate; peristome reflected; the throat many-folded: two folds on the columella and on the parietal wall, in the palate five or six. Length 5, diam. 1⅔ lines; whorls 11 (*Rossm.*).

Dalmatia.

Pupa pachygaster Ziegler in coll. — *Pupa pachygastra* Ziegl., Rossmaessler, Iconogr., i, pt. 5, 1837, p. 11, pl. 23, f. 314 (*P. oblongata* on plate).—Kuester, Conchyl. Cab., p. 38, pl. 5, f. 11-15; Zehnter Bericht der naturf. Ges. Bamberg, 1875, p. 56. — *P. pachygastris* Ziegler, Kuester, 9ter Ber., Bamberg, p. 95. — *Torquilla polyplicata* Mühlfeldt MS., Rossm., *l. c.*, in synonymy.

This form is more glossy and less distinctly striate than *A. frumentum;* there is no whitish callous behind the lip; the angular and parietal lamellæ are a little further apart, the parietal lamella is less regularly arcuate, viewed from below; the spiral lamella is longer and slightly curved (fig. 7). Kuester (1875) has argued that it differs specifically from *frumentum*, which may be true, but most authorities have reckoned it a variety. Specimens from Riva measure 8.5 to 10 mm. long. Rossmässler's figures are copied in pl. 42, figs. 10, 11.

A. frumentum castanea Gredler. "Nearly of the size and shape of *elongata* Rssm., with which it lives, but beautiful reddish brown. This extremely notable color-variety—if not a hybrid of *frumentum* and *megacheilos*—extends only along a fifteen-minute stretch between Nago and Torbolo, in the Sarkathal, but is found in abundance here on the road walls, as well as upon Mt. Brione" (*Gredler*).

Described as a variety of *P. frumentum*, but it may belong rather to *A. illyrica*. I have not seen it.

Pupa frumentum var. *gigantea* Schröder, Beiträge zur Konchylienkunde Tirol und Italienschen Grenzgebiet, 1910, p. 40. The publication is not accessible to me.

31. ABIDA ILLYRICA (Rossm.). Pl. 42, figs. 8, 9.

The shell is usually somewhat larger (than *frumentum*), more slender, with the summit drawn out longer, and the striation finer and irregular; a callous (behind the lip) is entirely wanting (*Rossm.*). The angular lamella is slightly forked in front, and is often almost continuous with the spiral lamella. A quite small twin lamella runs inward from the callous at the posterior angle of the lip. The palatal plicæ emerge further on the lip, and the sutural plica is longer than in *frumentum*. There is sometimes a small infrapalatal plica.

Length 10 to 11, diam. 3.5 mm.; 10 to 11 whorls.

Carinthia, Dalmatia, southern Tirol.

Pupa frumentum var. *illyrica* ROSSMAESSLER, Iconogr., i, p. 82; Heft. 5, p. 11, pl. 23, fig. 312.—PAULUCCI, Bull. Soc. Malac. Ital., vii, p. 118.—*Pupa illyrica* Rm., CAZIOT, Bull. Soc. Zool. Fr., xxxv, 1910, p. 159.—*Pupa frumentum* var. *elongata* Rossm., Iconogr., 5, 1837, p. 11, pl. 23, f. 313.—*P. adjuncta* Ziegler MS., in Rossm., *l. c.*—*Pupa frumentum* var. *minor* ROSSM., t. c., 1837, p. 11, pl. 23, f. 311.—*Pupa cylindracea* Ziegler in coll., ROSSM., t. c., 1837, p. 12, pl. 23, f. 315.—KUESTER, Conchyl. Cab., p. 37, pl. 5, f. 9, 10.—PFR., Monogr., ii, 339.—*Torquilla triticum* Ziegler, STABILE, Fauna Elvetica, 1845, p. 40, fig. 35, with var. *parva* and *magna*.—*Pupa frumentum* var. *meridionalis* STROBEL, Notizie Malacostatiche sul

Trentino, 1851, p. 37. — "*Pupa triticea* Zeigler" Germain, Mollusques de la France et des régions voisines, ii, 1913, p. 176, footnote 1. — *Pupa frumentum* var. *major* Kreglinger, Syst. Verz. Deutschl. Binnenmoll., 1870, p. 192.

This form has generally been ranked as a variety of *A. frumentum*, but possibly the relations of the various forms may appear clearer by giving it specific standing, as Commandant Caziot holds. This author (*t. c.*, p. 156) has wholly misunderstood Rossmaessler's plain statement that *P. callosa* Ziegler (undescribed) is typical *frumentum*, and the other Illyrian form which Ziegler thought was *frumentum* is the new variety *illyrica*.

Torquilla triticum Ziegler, from Dalmatia, was mentioned by Porro, 1839 (with the undefined varieties *elongata* and *curta* Z.), and by Villa, 1841, but it was first described by Stabile, whose diagnosis and figures show it to be identical with *illyrica*. The following dimensions are given by him.

Length 10, width in the middle 3½ mm. (*triticum*).

Length 9, width 3½ mm. (var. *parva* Stabile, Bianza, Lombardy).

Length 12, width 3½ mm. (var. *magna* Stabile).

The following described varieties are referable to *illyrica* as races or local forms of some degree.

A. illyrica elongata Rossm. Pl. 45, fig. 4. Shell larger, darker, rather cylindric, pointed, without cervical callous, the folds strongly developed. Very abundant on a low, shrub-covered breastwork, Passeggio a S. Andrea, near Triest; also from Windischgraben near Ferlach in Carinthia. This form is *P. adjuncta* Zgl. (*Rossm.*).

A. illyrica minor Rossm. Pl. 45, fig. 3. Shell smaller, weaker, with the palatal plicæ not very well developed, generally only the median two fully developed, and without a cervical callous. I found this form on the Karst between Opchina and Sessana, under limestone blocks, and near Laibach on limestone cliffs, especially on the Grossgallenberge and near Verbleine, at the last place in company with var. *illyrica*.

Sent by Parreyss from St. Gotthardt (*Rossm.*). The length is slightly over 7 mm.

A. illyrica cylindracea ('Ziegl.' Rm.). Pl. 45, figs. 1, 2. Shell rimate, *cylindrical*, acute, rather glossy, buff-corneous, last whorl subangular. Aperture rounded-semiovate; throat 8-plicate, two folds on the columella and on the parietal wall, 4 in the palate. Length 5½, diam. 1½ lines; 10 to 11 whorls. Almissa, Dalmatia, Ziegler (*Rossmaessler*).

A. illyrica kanalensis (Caziot). Shell shining, rufous, very delicately, regularly striate, ventricose, conic at apex; last whorl very little calloused anteriorly. Aperture 11-plicate: 5 palatals, 3 columellar, the upper one small, dentiform, parietal wall 2-plicate (the median very high, compressed; within, towards the suture a small but distinct fold), angular lamella 1, thickened tooth-like above. Length 5½–7, diam. 2⅔–3 mm. (*Westerlund*).

Carinthia: Kanal valley, abundant.

Pupa frumentum var. *polita* Westerlund, Fauna Europæa Moll. Extramar. Prodr., ii, 1878, p. 171; Fauna Paläarct., iii, 1887, p. 107. Not *Clausilia polita* Risso. — *Pupa kanalensis* Caziot, Bull. Soc. Zool. France, xxxv, 1910, p. 158, *n. n.* for *polita* West.

Commandant Caziot believes this to be a distinct species, stating that it is characterized by the presence of a third columellar lamella; but this is also present in many of the forms of the *frumentum* series. It has not been figured.

A. illyrica gastrodes n. var. Pl. 46, fig. 6. The shell is smaller than *illyrica* and typically more ventricose; lamella as in *illyrica*. Length 9, diam. above aperture 3.5 mm., 8⅔ whorls. Type no. 22859 A. N. S. P. was labeled *P. gastrodes* Z. Verona.

32. Abida apennina (Charp., Küster). Pl. 42, figs. 12 to 16.

Shell obliquely rimate, cylindric-fusiform, obliquely ribstriate, corneous-buff; spire tapering in an acute cone above the middle; whorls 10, slightly convex, the last compressed at base. Aperture semioval, many-folded, three folds on the

parietal wall, the angular lamella being doubled, two on the columella, five in the palate; peristome expanded and a little reflected. Length 4–4½, diam. 1¼–1¾ lines (*Kuester*).

Central Italy: The Appenines between Genoa and Ascoli (Charp.); Camporbiano near Volterra, Tuscany; Avellana, Umbria; Monte Maielle, Abruzzo (Paulucci).

Pupa apennina Charpentier in litt., KUESTER, Conchyl. Cabinet, *Pupa*, p. 105, pl. 14, f. 25-28. — *Pupa frumentum* var. *apennina* Charp., PAULUCCI, Matériaux, etc., 1878, pp. 10, 36; Bull. Soc. Malac. Ital., vii, 1881, p. 117.

The accessory lamella between the angular and the end of the outer lip is more developed than in *illyrica* or any form of the *frumentum* series. The angular lamella approaches the parietal rather closely. The spiral lamella is long, as in *illyrica*. The parietal lamella has a longer inward continuation than I have seen in any other of the *frumentum* group. On the last half-whorl the white lines over the palatal plicæ are conspicuous. The specimens examined are larger than the types of Kuester, measuring from 10 mm. long to: length 11, diam. 4 mm.; 10½ whorls.

Figs. 12 and 15 are copied from Kuester. Fig. 16 from a specimen from Mme. Paulucci, and figs. 13, 14 specimen from Terver.

It has often been considered a variety of *frumentum*, but it is more distinct than any of the other forms.

Series of A. secale.

33. ABIDA SECALE (Drap.). Pl. 47, figs. 11, 13, 14, 15.

The shell is minutely perforate, cylindric, the upper half or third tapering to the obtuse apex; cinnamon-brown (but varying from much darker to paler); finely striate. Whorls slightly convex, the last rounded below, and showing whitish lines over the internal plicæ. Aperture brown within, the teeth whitish. Angular lamella continuous with the spiral, which penetrates as far as or a little beyond the parietal (fig. 11). A short twin-lamella within the lip-insertion. Parietal lamella high in the middle, tapering towards both ends. Columellar lamella a little stronger and longer than the sub-

columellar. Upper and lower palatal and basal plicæ emerge, the upper to the margin, the others to the inner edge of the peristome; their inner ends are well in advance of a mid-dorsal position, and a short suprapalatal plica stands above them. Peristome expanded, whitish, the ends joined by a thin parietal callous.

Length 8, diam. 3 mm.; 9¼ whorls.

Length 6.4, diam. 2.7 mm.; 8½ whorls.

England, in the Channel and Thames counties; France, Germany, Austria, Switzerland, and northern Italy.

Pupa secale Draparnaud, Tabl., 1801, p. 59; Hist. Moll. France, 1805, p. 64, pl. 3, f. 49, 50.—Kuester, Syst. Conch. Cab., p. 44, pl. 6, f. 3-5; Ber. Nat. Ges. Bamberg, x, 1875, p. 57.—Pfeiffer, Monogr., ii, p. 341; iii, 546; iv, 672; vi, 313; viii, 382 (see for older references). — Forbes and Hanley, Brit. Moll., iv, p. 101, pl. 129, f. 5.—Moquin-Tandon, Moll. Fr., p. 366, pl. 26, f. 26-29.—Lindstrom, Gotl. nut. moll., p. 47, pl. 1, f. 12 (jaw).—Bgt., Malacologie Aix-les-Bains, p. 48. —Westerlund, Fauna, iii, 1887, p. 110.—Caziot, Ann. Soc. Linn. Lyon for 1908, p. 169 (synonymy, distribution, etc.).—*Chondrus secale* Cuvier, Regne Anim., ii, p. 408. — *Abida secale* Leach, in Turton, Manual, 1831, p. 101. — *Torquilla secale* Dr., Boettger, Jahrb. Nassau. Ver. Naturkunde, xlii, 1889, p. 248 (distribution).—*Turbo juniperi* Montagu, Testacea Brittanica, pt. 2, 1803, p. 340, pl. 12, f. 12 (Easton Grey and Devizes, Wilts.).—*Pupa juniperi* of some authors.—*Turbo cylindricus* Hartmann, Alpina, ii, p. 212 (*teste* Pfr.).—*Pupa* "*secalina* Drapernaud" Locard, Bull. Soc. d'Agric. Lyon, 1896, p. 194, fig. 426-7.

This common species varies rather widely in shape, size, sculpture and teeth, even in the same locality. In many places specimens are found having a low lamella close to the columellar insertion (figs. 1, 13), usually occurring with individuals without that structure (fig. 14). A small denticle is often developed at the base of the columella (fig. 15). These and other variations have led to the description of numerous "varieties" and "species" which are noticed below, though many of them appear to me quite superfluous.

The description, measurements and figures are from specimens from Lyons.

Form *novemplicata* 'Bgt.' West. This variety differs from the type by the large fold situated at the upper angle of the outer lip, which is completely divided into two. Aix-les-Bains. It was described by Bourguignat but named by Westerlund. Probably an individual variation or pathologic.

Pupa secale var. *minor* Michaud, Complément de l'hist. nat. des moll. terr. et fluv. de la France, 1831, p. 65, based upon Draparnaud, pl. 3, f. 49, 50. Length of figure 6.8 mm. This would appear to be a small form of typical *secale*. Westerlund has a "form *minor*, small, thin, nearly smooth, otherwise quite typical, length 6½, length 1¾ mm." (Fauna, iii, 1887, p. 110).

Var. *cylindroides* Moquin-Tandon. Shell more cylindric; aperture with same folds. Pyrénées-Orientales at Villefranche and Gavarnie (Hist. Moll. Fr., 1855, p. 366).

Var. *elongata* Saulcy. Length 9 mm. Along the Gave near Saint-Sauveur, Hautes-Pyrénées (Journ. de Conch., 1853, p. 270).

Var. *sarratina* Moq.-Tand. Shell a little smaller; aperture with the large fold of the parietal wall almost double; a low accessory fold at the angle of the columellar lip. Durfort, near Saint-Ferréol (Hist. Moll. Fr., 1855, p. 366).

Var. *siligo* Roth. One or two little accessory folds at the angle of columella and parietal wall. Bavarian Alps and along the Isar. (*Pupa secale* var. *siligo* Roth, Malak. Bl., ii, 1855, p. 41. Var. *seligo* West., Fauna, iii, p. 110.)

Var. *gracilior* Kreglinger. Differs from *secale* in that it is more slender, has one more whorl (9½–10), and there is one fold less in the mouth. Length 3½, breadth 1 line. Lahr, near Zierenberg, in company with *P. secale*, rare. (*Pupa variabilis* C. Pfeiffer, Syst. Anord. u. Beschreib deutscher Land- und Wasser-Schnecken, i, 1821, p. 56, pl. 3, f. 15, not of Drap.—*Pupa secale* var. *gracilior* KREGLINGER, Syst. Ver. Deutschl. Binnen-Mollusken, 1870, p. 194, based upon C. Pfeiffer's descript. and fig.—Westerlund, Fauna, iii, 1887, p. 110.)

Var. *hordeum* ('Stud.,' Hartm.). Pl. 47, fig. 16. "[*Tor-*

quilla] *hordeum*(?) Mihi. Somewhat smaller than the preceding [*avena* Drap.], and perhaps often confused with it, but appears to be different." (*Studer*, Kurzes Verzeich., 1820, p. 89.)

The name was next used as "*Chondrus secale* var. *Ch. hordeum*" by Hartmann, System der Erd- und Süsswasser Gasteropoden Europa's, in Sturm, Heft 5, 1821, p. 50, no description; Sturm's Deutschlands Fauna, vi, Abth., Die Würmer, 7. Heft, 1824, pl. 5, and accompanying text (lettered on plate "*Chondrus secale* Cuv. var. *hordeum* Aud.," apparently an engraver's error for *Stud.*). Hartmann refers to Studer's *Torquilla hordeum* as identical. He gives the localities: *bei Bern fand sie Herr Professor Studer;* also Sarganserland and Zürich. Hartmann notes that it is shorter and somewhat more ventricose than *secale*, 3 lines long, and of 8 whorls. His figure is copied, pl. 47, fig. 16.

As this was the first recognizable definition of Studer's form, and in all probability founded upon specimens from Studer, the name *hordeum* should be restricted to Bern shells agreeing with Hartmann's figure.

In his Catalogue des Moll. terr. et fluv. de la Suisse in Neue Denkschr. der allg. Schweizerischen Ges. gesammten Naturwiss., i, 1837, p. 16, pl. 2, f. 7, Charpentier records, "Rare. Roches Calcaires: Devens, Pierre à Besse," and gives figures which represent a long, cylindric form probably of *secale*, length 12.5 mm.

Westerlund (Fauna, iii, p. 110) has accepted this form to represent *hordeum;* yet Charpentier's form is certainly not that of Studer or Hartmann. Comm. Caziot has also discussed *hordeum*, Feuille Jeunes Naturalistes, 1910, no. 474, p. 94, but without knowing of Hartmann's publication, which appears to me the only important work on the variety.

Var. *cylindrica* Locard. Shell of a somewhat cylindric, elongate shape, not swollen, measuring 8-9 mm. long, with whorls but little rounded. Aperture with 9 folds, having an inconspicuous fold at the angle of the columellar margin. Debris of the Rhone (Variations Malac., 1880, p. 259).

Var. *decemplicata* Bourguignat MS., Locard. Shell resem-

bling the type, but with 4 superior folds, 2 columellars and 4 palatals; "resembles the preceding variety, differing only by a little fold, very thin and long, which follows the upper angle of the columella. This variety imitates *P. boileausiana* Charp." Environs of Aix-les-Bains, and in drift of the Rhone (Locard, Variations Malac., 1880, p. 259).

Var. *oyonnaxia* Locard. Shell resembling the type, but with 10 folds disposed thus: 3 superior, the little fold of the upper angle of the outer lip often not very distinct, 3 columellar folds, and 4 palatal folds; the third columellar fold is very low down and emerges but little, it is very distinct in some specimens; rare. Oyonnax (Ain). Loc., Var. Mal., 1880, p. 259.

Var. *bourgetica* Bourguignat. Aperture 11-plicate, 4 folds on the parietal wall, 3 columellar and 4 palatal. This variety is distinguished from the preceding [var. *decemplicata*] in that the columella instead of having 2 lamelliform folds presents besides a third punctiform fold at the base. Aix-les-Bains (Savoie). *Pupa secale* var. *bourgetica* Bgt., Malac. d'Aix-les-Bains, 1864, pp. 49, 50, pl. 2, f. 1.—Letourneaux, Moll. Lamalou, p. 64.

Var. *sublaevigata* Bourguignat MS., Locard. Has the same characters as the preceding, except that the shell is nearly smooth and under the lens does not show the fine, oblique, crowded striæ which characterize the type. Dent-du-Chat, in Savoie. Locard, Var. Malac., 1880, p. 260.

Var. *duodecimcostata* Locard. The shell conforms to the type but is a little larger, ornamented with 12 folds disposed thus: 4 superior, 2 columellar, the upper strongly developed, 6 palatals, the upper deeply immersed, the second and fourth very prominent, the other three reduced to punctiform folds, little immersed. Environs of Lyons and Vernet, coll. of M. Gabillot. Locard, Var. Malac., 1880, p. 260.

Var. *edentula* Taylor. Shell smaller, thinner, smooth and glossy; striation regular, and fine on the upper whorls, gradually becoming fainter and more irregular on the lower ones; apertural plications obsolete. This variety was found by me in September, 1877, at the foot of the rocks near Ingleton in Yorkshire. The specimens of the type found in company with it partake of many of the peculiarities enumerated. It furnishes an approach to the continental species, *Pupa avena* (Taylor, Journal of Conchology, 1879, p. 5).

Var. *oryzana* Locard. Ovoid, somewhat slender, of 7-8 quite convex whorls; 3 superior folds, the first two contiguous, lodged near the suture, third immersed; 3 columellars, the

first sometimes obsolete, lodged below the upper angle of the margin, the second stronger than the third, almost marginal; 3 palatals approaching the peristome, the second a little the strongest. Shell corneous-red, quite glossy, striæ fine and regular. Length 6, diam. 1¾ mm. Aude, Vaucluse, Drôme, Isère, Jura, etc. (*Pupa oryzana* Loc., Bull. Soc. Agric. Lyon (7), iii, 1896, p. 194).

Var. *lasallei* 'Bourg.' Locard. Ovoid, a little short and stout, feebly tapering above, of 8-9 convex whorls; 4 superior folds, the first and last nearly rudimentary, lodged in the two angles; 3 columellars, the last much immersed; 4 palatals, the first and last very small, the other two attaining the margin. Peristome reflected, quite thick; shell glossy-red, ornamented with fine and very crowded striæ. Length 6–7, diam. 2¾–3 mm. Aude, Saone-et-Loire, Haute-Savoie, Ardèche, etc. (*Pupa lasallei* Bgt. in coll., *Locard*, Bull. Soc. Agric. Lyon (7), iii, 1896, p. 196).

Var. *kraliki* Let. Shell perforate (perforation spreading, deep), minute, cylindric, tapering, glossy, corneous, elegantly striate (the striæ like riblets, straight, oblique, close, and stronger towards the aperture). Spire little lengthened, shortly tapering; apex obtuse, smooth, paler. Whorls 9, a little convex, slowly increasing, separated by a moderately impressed suture, the last compressed outside, ascending to the lip-insertion, carinate at the base (the carina subobtuse, arcuate, not reaching the periphery). Aperture nearly vertical, lunate, buff within, somewhat semioblong, with 11 folds: *Parietals* 4, of which there are two angulars (one minute, the other very long, running into the throat and enlarging); a narrow lamella at the angle at top of the columella; and a remote, robust lamelliform tooth within in the middle of the parietal wall. *Columellars* 3, the upper one strong, robust, emerging to the margin, another minute, rather deep within, and a lower punctiform. *Palatals* 4, of which the upper is very deep within, scarcely visible in the mouth, the others very strong, robust, lamelliform, reaching to the margin. Peristome thickened, a little expanded throughout, the margins approaching and connected by a thin callous. Alt. 6½, diam. 2½ mm. (*Pupa kraliki* Letourneux, Revue et Magazin de Zool. (3), v, 1877, p. 348.) France, Dép. Hérault, aux Douze, near Lamalou-les-Bains, under stones; rare.

According to Letourneux, this species is remarkable not only for the apertural folds which are exactly opposite one another and almost touching, but also by their form; instead

of being thin and sharp, they are broad, thick, tuberculose, as though crushed down. As only three specimens were found, I suspect that it may be an abnormal form.

Var. *phymata* West. Very beautifully, hair-fine striate, the striæ stronger and more spaced on the last whorl, reddish-yellow, whitish towards the aperture, the last whorl with a white hump on the base; margin thickened throughout, white-lipped, narrowly reflected; aperture with 8 lamellæ and plicæ: 2 parietal, 2 columellar, 4 palatal (the first small, deep within, second to fourth marginal, second and third elevated within, obliquely truncated, beyond which they continue inward as small folds). Length 7, diam. 2 mm. Hautes-Pyrénées (*Pupa secale* var. *phymata Westerlund*, Fauna, iii, 1887, p. 110).

Var. *piniana* Fagot. Shell minutely perforate, regularly conic-elongate, horn-brown or violet, very closely striate, scarcely shining. Spire lengthened, slowly increasing. Whorls 8, scarcely convex, regularly increasing, the last larger, somewhat compressed around the umbilicus. Aperture oblique, truncate-oblong, with 8 lamellæ and folds: 2 parietal, 2 columellar, the upper nearly marginal, lower immersed, 4 palatal plicæ, the first very small, very deep within, second marginal, third somewhat and fourth more immersed. Peristome acute, margins separated, the outer expanded, columellar reflected. Length 7, diam. 2¼ mm. (*Westerlund*). France: Ponech (Ariège). *Pupa piniana* Fagot, Bull. Soc. Agr., Sc. et Litt. Pyr.-Or., 1880; Westerlund, Fauna, iii, 1887, p. 111.

Abida secale boileausiana ('Charp.' Küster). Pl. 46, fig. 11.

A species of the group of *P. frumentum*. The shell is obliquely rimate, subperforate, somewhat lengthened conic, finely and obliquely rib-striate, satin-shining, light corneous-yellow. The spire is somewhat fusiform, apex obtuse, the 9 or 10 whorls narrow, very slowly increasing, weakly convex, united by a simple, little-impressed suture, the last whorl contracting, weakly compressed below, the base rounded. The aperture is lengthened, rounded, yellowish flesh-colored, with 8 snow-white folds, of which three are on the parietal wall, the first and largest arising from the insertion of the peristome, the second deep within, the third near the angle formed by the parietal wall and columella. On the columella there are three folds, and in the palate three, the upper one largest and emerging to the edge of the lip; above it the beginning

of a fourth palatal fold may be seen deep in the throat; all are visible as white lines on the neck. The peristome is white, a little thickened, expanded. Length 3–3⅓, diam. 1⅕ lines (*Kuester*).

Southern France (Charpentier). Departments Ariège, Hérault, Haute-Garonne, Pyrénées-Orientales, etc. (Locard).

Pupa boileausiana Charpentier Kuester, Conchyl. Cab., Pupa, p. 98, pl. 13, f. 21-23.—Dupuy, Moll. France, p. 386, pl. 19, f. 3.—Pfr., Monogr., iii, 546.

This race has been reported from Dorridge, near Knowle, Warwickshire, by Taylor (Journ. of Conchol., ii, 1879, p. 5), but as the characters of small size and a fold on the parietal wall contiguous to the columella are common in other races of *secale*, it seems unlikely that the real *boileausiana* occurs in England.

Var. *fagorum* 'Fagot' Locard. Shell more strongly and a little more distantly striate; base of the aperture more retuse; lamella at the columellar angle more distinct and always present; parietal lamella more immersed. Length 6-7, diam. 2 mm. (*Pupa boileausiana* var. *fagorum Westerlund*, Synopsis, p. 89). *Pupa fagorum* P. Fagot in coll. Brgt., Locard, Ann. Soc. d'Agricult., Sc. et Ind. Lyon (7), iii, 1896, p. 196. France: Aulus (Ariège); Quillan, Limoux, mont Alaric (Aude).

Abida secale gourdoniana Fagot. Aperture 8-toothed; 2 parietals, 2 strong, deeply placed columellars, 4 palatals, of which the lower is rather immersed, the middle strong, less remote, the third nearly attaining the margin, the fourth smallest, tubercular, situated below [above] the middle of the third [or upper palatal]. Peristome thick, interrupted, reflected throughout. Alt. 8, diam. 2–2½ mm.; 9 whorls. Terminal cone of the pic du Gar (Haute-Garonne). *Pupa gourdoniana* Fagot, Moll. Pic du Gar, 1882, p. 11; Bull. Soc. d'Hist. Nat. Toulouse, 1882, p. 74.—Gourdon, Feuille Jeunes Nat., 1895, no. 293, pp. 75, 91. Gourdon adds the localities montagne de Cierp, and limestones at entrance of the Val de la Hosse at Barousse. He thinks it belongs rather to the *pyrenæaria* group.

Abida secale abrupta West. Shell minutely perforate,

cylindric-fusiform, regularly but extremely finely and closely striate, light corneous-yellow, thin, somewhat glossy, with slowly tapering spire; whorls 8-9, a little convex, the last rounded at the base; aperture somewhat contracted but rounded below. Parietal lamellæ 2, the angular short, slender, *simple and wholly without* thickening. Columellar lamellæ 2, the upper strong within, slenderly emerging nearly to the peristome, the lower lamella shorter and slenderer. Palatal plicæ 4, the upper punctiform, deep within, second interrupted in the middle, marginal, the third having two lumps in the middle, shorter, fourth still more immersed. Peristome *thin, simple*, the margins *widely* separated, weakly reflected, white, columellar margin rather straightened, the outer margin strongly curved above. Length 6½–7, diam. 2 mm. France: Aulus. *P. secale* var. *abrupta Westerlund*, Fauna Europ., 1876, p. 172; Fauna, iii, 1887, p. 111.)

Abida secale costata 'Fagot' Locard. Shell reddish-violaceous, glossy, ornamented with strong, rather widely spaced riblets. Two parietal folds, 2 immersed columellar, 2 subequal palatals emerging to the peristome, which is slightly expanded and a little thickened. Length 6-7, diam. 2½ mm., 7-8 quite convex whorls. France: valley of Ossoui (H.-Pyrénées); gorge des Eaux-Chandes (B.-Pyr.). *Pupa costata* Fagot in coll. Brgt., Locard, Bull. Soc. d'Agric., etc., de Lyon (7), iii, 1896, p. 195.

34. Abida cadica ('Fag.' West.). Shell cylindric, tapering a little above, densely hair-striate, corneous; 8½ slightly convex whorls, the last slightly ascending, obtusely crested at base. Aperture narrow, the base narrowed in the middle, channelled; with 8 folds, 2 parietal, 2 columellar, 4 palatal (the angular short, parietal median, columellars short, immersed, distant, the upper larger; first palatal immersed, small, the lower three subequal, submarginal, prolonged inwardly but little; peristome continuous. Length 6, diam. 2 mm. A species of the group of *P. secale*. *P*[*upa*] (*Torquilla*) *cadica* Fagot *in sc.*, Westerlund, Nachrbl. d. Mal. Ges., Apr. 1902, p. 39.) Spain: Sierra de Cadi (P. Fagot).

Probably distinct from *secale*, as it is beyond the known range of that; but if so, the description is insufficient.

Series of A. micheli.

Slender, corneous species of southeastern France and northern Italy.

35. ABIDA MICHELI (Terver). Pl. 45, figs. 8, 9.

Shell punctiform-umbilicate, elongate, subcylindric, rather glossy, delicately costulate-striate, corneous-yellow; whorls 9, narrow, nearly flat. Aperture semiovate, 8-plicate: 4 plicæ in the palate, the upper very short, deeply placed; 2 on the parietal wall, the others on the columella; peristome white-lipped, reflected. Length 2.5, width .8 lines (*Kuester in litt., Pfr.*).

Southern France: from dép. Herault to Alpes-Maritimes; type loc., environs of Toulon (Terver).

Pupa michelii Terver MS., DUPUY, Hist. Nat. Moll. terr. et d'eau douce France, 1850, p. 397, pl. 19, f. 11. — KUESTER, Syst. Conchyl. Cab., *Pupa*, p. 106, pl. 14, f. 29-31. — PFR., Monogr., ii, 1848, p. 340.—WESTERLUND, Fauna, iii, 1887, p. 119; Synops. Moll. Extramar., 1897, p. 91. — LOCARD, Ann. Soc. d'Agricult. Lyon (7), iii, 1896, p. 204.—*Pupa columnella* Loc., LOCARD, t. c., p. 205; *P. olearum* Bgt., *P. magdalenae* Bgt., *P. rusticula* Bgt., *P. valcourtiana* Bgt., in LOCARD, t. c., p. 206.—*P. micheli* Terver, CAZIOT, Etude Moll. Monaco, etc., 1910, p. 325.

The angular lamella is low, very long, almost doubled above; upper columellar lamella high within, diminishing towards the margin, the lower one immersed. Palatal plicæ 4, the upper very small, deep within, second marginal; second, third and fourth of equal length within, penetrating to about the middle of the whorl. Length 5-6, diam. 1.75 mm. (*Westerlund*).

Several supposed species described from southeastern France, in the departments B.-du-Rhone, Var, Basses-Alpes, etc., are apparently synonyms or perhaps varieties of *micheli;* the descriptions follow.

Pupa columnella Loc. Narrowly cylindric, a little tapering, quite obtuse at the summit; 8-9 quite convex whorls, the suture marked. Aperture small, regularly ovate, a little elon-

gated; one lamellar superior fold, median and immersed; two very small columellars, deeply immersed and tubercular; four immersed and tubercular palatals, the third a little stronger, the fourth obsolete. Shell light red, ornamented with strong striæ, somewhat spaced and quite regular. Length 6½, diam. 1¾ mm. Rare; les Angles (Basses-Alpes). Locard, Ann. Soc. de l'Agricult. de Lyon (7), iii, 1896, p. 205.

Pupa olearum 'Bgt.' Loc. Cylindric-elongate, a little ventricose, quite rapidly tapering to the summit; 9-10 whorls a little convex, progressive, the suture quite marked. Aperture small, ovate, well rounded at the base; 2 superior folds, the stronger lodged at the suture, the other immersed; 2 subequal columellars, quite strong but immersed; 2 subequal palatals, only the upper attaining the peristome. Peristome subcontinuous, a little thickened, slightly everted. Shell solid, subopaque, slightly yellowish red, ornamented with very fine, very crowded, quite regular striæ. Length 8, diam. 2 mm. Quite rare; Ollioules (Var); environs of Marseilles and of Arles (B.-du-R.). *Pupa olearum* Brgt. in coll., Locard, t. c., p. 206.

Pupa magdalenae 'Bgt.' Loc. Small, conoid, quite narrow, slowly tapering to base and summit; 8-9 slightly convex whorls, the suture not deep. Aperture small, somewhat rounded; 2 subequal superior folds, the first lodged at the suture, the second median and immersed; 2 columellars, the first very small and very deeply immersed, the second robust, but not reaching the peristome; 3 palatals, the first very small, the second strongest, and alone reaching the peristome. Peristome subcontinuous, a little thickened and reflected. Shell somewhat thin, brilliant, corneous-fawn, a little striolate. Length 6½–7, diam. 2 mm. Quite rare; Var, Bouches-du-Rhone, etc. (*Pupa magdalenae* Brgt. in coll., Locard, t. c., p. 206).

Pupa rusticula 'Bgt.' Loc. Small, a little ovoid-ventricose, quite rapidly tapering upwards. Eight to nine quite convex whorls, the suture quite marked. Aperture almost regularly oboval, a little contracted at the base; 2 superior folds, the first accompanied by a slight tubercle and lodged at the suture, the second median and immersed; 2 strong columellars subequal, distant and immersed; 3 palatals, the first strongest and reaching the peristome, the last very small. Peristome subcontinuous, a little thickened and reflected. Shell corneous-red, glossy, a little striolate. Length 6-7, diam. 2½ mm. Rare; Saint-Auban, near Briançonnet (Alpes-Maritimes). *Pupa rusticula* Brgt. in coll., Locard, t. c., p. 206.

Pupa valcourtiana 'Bgt.' Loc. Shell cylindric, short, rapidly tapering to the summit. Seven to eight slightly convex whorls, the suture quite marked. Aperture obovalrounded, not contracted at base; 2 thin superior folds, the first lodged at the suture, the second median and immersed; 2 immersed columellars, the first one stronger; 3 palatals, the first two reaching the peristome, the third small. Peristome subcontinuous, feebly thickened, a little everted. Shell corneous-red, a little glossy, slightly striolate. Length 6, diam. 2 mm. Rare; clus de Saint-Auban (Alpes-Maritimes). *Pupa valcourtiana* Brgt. in coll., Locard, t. c., p. 206.

36. ABIDA ANCEYI (Fagot). Pl. 45, fig. 10.

Shell minutely perforate, subfusiform-elongate, conic, corneous-rufous, glossy, pellucid, hair-striate (the striæ oblique, irregular, in the last whorl distant and disappearing). Spire long, acuminate, the apex obtuse, mamillate. Whorls 10, the first convex, the rest a little convex, slowly and regularly increasing, separated by a well-impressed suture; the last whorl slightly larger, ascending at the aperture, and a little compressed around the perforation. Aperture oblique, oblong-rounded, 7-plicate: parietal plicæ 2, the angular tuberculose, the other deeply placed, rather strong; 2 columellar plicæ, rather remote in the throat, the upper one less remote; 3 palatal plicæ, the inferior small, remote, the middle one strong, elongate, projecting nearly to the outer margin, the upper not marginal, long and interrupted. Peristome thickened, expanded throughout, the margins remote, subequal. Length 7, diam. 1½ to 1¾ mm. (*Fagot*).

France: Val de Crède, near Marseilles (Bouches-du-Rhone).

Pupa anceyi FAGOT, Bull. Soc. Zool. France, vi, 1881, p. 139.

"This new species, discovered by M. Ancey, to whom it is dedicated, belongs to the group of *Pupa mortilleti* and *micheli;* but it is separated from the former by the more delicate dentition, from the second by the different dentition, and from both by the slimmer shape, recalling that of *Pupa granum*" (*Fagot*).

There is no spiral lamella. The upper and lower palatal and the basal plicæ are all strengthened into rather strong

folds in the dorsal position, and again at the inner margin of the peristome. The lower palatal, though deeply excised, is continuous to the margin, and its inner enlargement is visible from in front; the upper palatal is nearly continuous, but the basal is interrupted, and the inner folds of these two do not show in a face view. Both palatals have more or less developed thread-like continuations inward, visible as light lines outside. The exterior is almost smooth. The figured topotype measures, length 6.7, diam. above aperture 2 mm.; 9 whorls.

37. ABIDA STABILEI (Martens). Pl. 45, figs. 5, 6, 7.

Shell obliquely rimate, subcylindric-fusiform, rather smooth, somewhat shining, corneous. Spire gradually tapering, rather acute; whorls 9, scarcely convex, the last slightly narrower, compressed preceding the aperture; suture moderately distinct. Aperture semioval, 7-plicate; angular lamella moderately or very short and thick; median parietal lamella immersed, deeply entering; two columellar lamellæ approximate, deeply placed, tooth-like; three palatal plicæ, of which the upper (towards the suture) is very deeply immersed, very short and callous, often continued inward, very thin and long; towards the margin of the peristome there is often an inconspicuous callous which appears to be its forward continuation, but there is always an interruption. The second (or middle) palatal plica is long and strong, and reaches to the peristome; the third or basal plica, situated at the cervical compression, is very small and rudimentary. Peristome interrupted, moderately reflected and expanded, not thick, whitish, with the extremities a little converging. Length 6–7, diam. 2–2½ mm. (*Stabile*).

Italy, Piedmont: Susa, Valle Dora Riparia at 5-600 meters; alpine meadows above Crisolo, on Monte-Viso, 1600-1800 meters; Valle Stura di Cuneo at Vignolo, 550 meters, and Rocca Sparvera, 560 meters; Limone; Valle del Gesso at Vernante, at the foot of the Col de Tenda. France: Briançon (Hautes-Alpes) at over 1300 meters, among limestone rocks on the Mont-Genèvre road (Margier).

Pupa mortilleti STABILE, Mollusques terrestres Vivants du

Piémont, 1864, p. 96, pl. 2, f. 4. — PFR., Monogr., vi, 313.— WESTERLUND, Malak. Bl., xxii, 123; Fauna, iii, 1887, p. 118.— MARGIER, Feuille jeunes naturalistes, 1896, no. 312, p. 240.— *Torquilla mortilleti* Stabile, POLLONERA, Atti R. Accad. Torino, xx, 1885, p. 688. Not *Pupa mortilleti* Martens, 1860.—*Pupa stabili* v. MARTENS, The Record of Zoological Literature, 1864, p. 233, substitute for *P. mortilleti* Stabile. — STABILE, Bull. Malacologico Ital., i, 1868, p. 34, name corrected to *Pupa stabilei.*

A species of the Alpine zone, which differs from *A. variabilis* by the small, slender, not swollen shape, which is fusiform like *P. avenacea,* or even somewhat subcylindric; the less solid shell, with the peristome not thickened and with 3 instead of 4 plicæ. Boettger (1884) regarded the form later named *limonensis* as typical *mortilleti.* Westerlund (1887) remarks that "the description of Stabile is not exact, apparently because he had specimens of *limonensis* also before him."

A. mortilleti simoni Bttg. Differs from the type [that is, from *blanci*] by the smaller shell, the aperture more rounded, subcircular, less strongly lipped, the angular lamella lower, palatal plicæ less deeply entering. Length 6–6½, diam. 2¼–2½ mm. Abundant on Mt. Cenis (*Bttg.*).

Pupa (*Torquilla*) *mortilleti* Stab. var. *simoni* BOETTGER, Nachrbl. d. m. Ges., 1884, p. 47.

Westerlund considers this a variety of his subsequently described *P. limonensis,* which is identical with *blanci* Poll. If this is correct, then the species will be called *A. simoni,* and *blanci* will become a subspecies, since *simoni* has priority. Having seen neither form, I am leaving *simoni* where it was placed by Dr. Boettger until the forms can be adequately revised.

38. ABIDA BLANCI (Pollonera).

Shell glabrous, corneous, elongate-fusiform or subcylindric-fusiform; whorls 9-10, very slightly convex, the last compressed before the rimation. Aperture semioval, 7-folded; one median parietal fold; a strongly angular fold, produced inward; two deeply-placed columellar folds, of which the

lower one is larger; three palatals, strong, very long within, joined to the lip-callous; peristome thick, reflected, white-lipped, exteriorly white calloused. Length 7-8, width 2½ mm. (*Pollonera*).

Italy: Limone, north of the Col di Tenda, in the Alpine zone, Piedmont (H. Blanc).

Pupa mortilleti, typus, BOETTGER, Nachrbl. d. m. Ges., 1884, p. 47, not of Stabile.—*T.* [*orquilla*] *blanci* POLLONERA, Atti R. Accad. del Sci. di Torino, xx, 1885, p. 688.—*Pupa limonensis* WESTERLUND, Fauna Pal. Reg. Binnenconch., iii, 1887, p. 118. —*Pupa limonensis* var. *isseli* CAZIOT, Étude. Moll. terr. et fluv. Principauté de Monaco, 1910, p. 312.

Differs from *mortilleti* (*stabilei*), according to Pollonera, by the less robust angular lamella, and the three palatal plicæ which extend to the peristome without interruption; the peristome is thicker and reinforced outwardly with a whitish callous.

Figures have been published by Caziot (Moll. terr. et fluv. Monaco, pl. 9, f. 17, 18), but they are too small and indistinct to be of use.

As there was no prior *Torquilla* or *Abida* named *blanci*, the name is valid. It is not a homonym of *Pupa blanci* Bourguignat. The substitution of *limonensis* by Westerlund was therefore superfluous.

The description of *Pupa limonensis* West., from the same locality and collector, here follows.

Shell rimate, cylindric-fusiform, nearly smooth, glossy, horn-colored. Whorls 9, scarcely at all convex, the last somewhat compressed below, whitish and thickened near the aperture. Aperture semielliptical, with 7 lamellæ and plicæ: 2 parietal lamellæ (the angular moderate); columellar lamellæ 2 (either both deep within, very small, or the upper small and tooth-like, the lower drawn out towards the margin). Palatal plicæ 3 (long, strong, marginal, *prolonged inward far beyond the middle of the whorl, the upper two even around to the columellar margin*). Peristome somewhat reflected, white-lipped, almost separated. Size up to 8 mm. long, 2½ wide (*Westerlund*).

Var. *isseli* Caziot. Differs from *Pupa limonensis* by its

smaller dimensions, more subcylindric shell which is not fusiform above, by the deeper suture, and the less rapid increase of the whorls. The disposition and number of the teeth and lamellæ is quite similar in the two forms, but the palatals and columellars are less robust in *limonensis*, and the parietals are stronger. Moreover, in this last species the two columellar lamellæ are almost united with one another and usually the lower one is stronger than the upper. In the var. *isseli* the two columellars are quite distinct, and the upper is especially more developed than the lower (*Caziot*).

Alpes-Maritimes: Vallée de la Roya, between 1500 and 2000 meters (Issel).

Series of A. variabilis.

Slender, somewhat fusiform species, in which the lower palatal plica emerges strongly, that above it weakly or immersed. Alpic.

39. ABIDA VARIABILIS (Drap.). Pl. 45, figs. 11, 12.

The shell is obliquely rimate, lengthened-fusiform, somewhat transparent brownish-corneous, *almost smooth;* earlier whorls convex, the later ones but slightly so, last whorl more or less completely encircled with whitish spiral lines. Aperture with 4 lamellæ and 4 plicæ: angular lamella short, somewhat thickened at the junction with outer lip; deep within, a short spiral lamella may usually be seen, but its presence is variable; parietal lamella entering to the dorsal side. Columellar and subcolumellar lamellæ equal, but the former enters further. *Upper palatal plica short, immersed,* remote from the lip; interpalatal weakly reaching the lip (or interrupted, immersed); *lower palatal stronger, emerging to the lip.* Basal plica short, *deeply immersed,* but sometimes having a weak continuation to the peristome. All of the plicæ are strongest within the dorsal wall, and are continued further inward as delicate threads, varying in length. The peristome is white, expanded and a little reflected, strongly thickened within except near the posterior angle.

Length 10.3, diam. 3.2 mm.; 10 whorls (Lyons).

Length 11.5, diam. 3.4 mm.; 10⅔ whorls (Lyons).

Length 7.2, diam. 2.5 mm.; 9 whorls (Lyons).

Length 9.2, diam. 3.3 mm.; 9⅓ whorls (Lyons).

Length 13.7, diam. 3.6 mm.; 11½ whorls (Nice).

Central France: southwest to dép. Pyrénées-Orientales, southeast to dép. Basses-Alpes. Bonifacio, Corsica, introduced. Italy: northern slopes of the Piedmont Apennines. Switzerland: around Geneva, Lausanne, etc.

Pupa variabilis Draparnaud, Tableau Moll. France, 1801, p. 60; Hist. Nat. Moll. France, p. 66, pl. 3, f. 55, 56.—Rossmaessler, Iconogr., pt. 5, pl. 10, fig. 309; pt. 11, p. 10, f. 725. —Pfeiffer, Monogr. Hel. Viv., ii, 340; iii, 546; iv, 672; vi, 313; viii, 382.—Westerlund, Fauna Pal. Reg. Binnenconch., iii, 1887, p. 117, with var. *angularis*, p. 118; Synops. Moll. Extramar. Reg. Pal., i, 1897, p. 81.—Caziot, Ann. Soc. Linn. de Lyon, lv, 1908 (1909), p. 155 (distribution); Étude sur les Moll. terr. et fluv. de la Principauté de Monaco, 1910, p. 322. —Locard, Ann. Soc. d'Agricult. Lyon (7), iii, 1895 (1896), p. 188, f. 422-3.—*Pupa ovulina, P. ischurostoma* Locard, *t. c.*, p. 189; *P. ebrodunensis, P. arctispira*, p. 190; *P. delphinensis, P. plagiostoma*, p. 191.—*Pupa multidentata* Oliv., Moquin-Tandon, Hist. Moll. France, ii, 1855, p. 374, pl. 27, f. 5-9 (not of Olivier).—Bourguignat, Malac. Aix-les-Bains, 1864, p. 47, with var. *sabaudina*, p. 48, pl. 2, f. 6, 7.—G. Nevill, P. Z. S., 1880, p. 125, with var. *polita* Risso, p. 126.—*Jaminia multidentata* Risso, Hist. Nat. Eur. Mérid., iv, 1826, p. 92.—*Clausilia charlotia* Risso, t. c., p. 86, pl. 4, f. 22.—*Helix* (*Cochlodonta*) *mutabilis* Férussac, Tabl. Syst., 1821, p. 60, based upon *Pupa variabilis* Drap.; with var. *pineta* Fér., undescribed.

This species is especially characteristic of the western Alps. While somewhat related to *A. frumentum*, it differs by the absence or small size of the spiral lamella (inward from the angular) and of the sutural plica, of which a trace may sometimes be seen, however; also by the immersed upper palatal and basal plicæ. The spire tapers more gradually, and the surface is almost smooth.

It varies widely in size in the same lots. The form called *sabaudina* by Bourguignat (pl. 45, fig. 13) is rather readily

recognizable, and somewhat widely spread. I have seen it from Lausanne (fig. 15), Lyons and elsewhere, *variabilis* occurring in the same districts, though not, probably, in the same colonies.

Minor variations, doubtless partly local or racial forms, have been named; part were ranked by their describers as "varieties," part as species, as follows:

Var. *major* Moquin-Tandon, 1855. Shell a fourth larger (than the normal size of 8-10 mm.). Grasse.

Var. *minor* Moq. Shell a fourth smaller. Ries, Montpellier.

Var. *labiosa* Moq. Shell of the same size (8-10 mm.), the peristome much reflected and very thick. Cette, Grasse.

Var. *pachygaster* Moq. Shell 8-10 mm., very ventricose, peristome quite thin. Montpellier, Avignon.

Var. *ovularis* Moq. Shell a third smaller, very ventricose, ovoid, peristome quite thick. Basses-Alpes.

Var. *incertus* Hartm. Pl. 46, fig. 9. Shell pale horn-color, 3 lines long, 1 wide; 8 apertural folds, 2 on the columellar, 4 in the outer margin, 2 on the parietal wall, of which one appears as a tubercle at the lip-insertion. Under stones and on rocks at Zurich, Switzerland (*Chondrus variabilis* var. *Ch. incertus* Hartmann, System der Erd- und Suesswasser Gasteropoden Europa's, 1821, p. 50, no. 20, no description; Neue Alpina, i, 1821, p. 218; and in Sturm's Deutschlands Fauna, vi Abth., 6 Heft, 1823, unnumbered page and plate, f. *a*, *B*.

Hartmann's figure, copied in fig. 9, shows *three* short folds above the long lower palatal, but the shape is that of *variabilis*.

Pupa ovulina Loc. Small, ovoid-swollen, tapering above and below; 8 rather close whorls, slightly convex, the suture marked; aperture small, straight, rather rounded; 2 superior folds, the largest at the suture, very flexuous, a little calloused; 2 rather strong columellars, far immersed, quite contiguous; 3 palatals, the upper two rudimentary and deeply immersed, only the third attaining the peristome; peristome a little reflected, quite thin. Shell thick, red, ornamented with nearly effaced striæ. Height 6½–8, diam. 3 mm. Not common. Gard, Vaucluse, Bouches-du-Rhone, etc. (*Pupa ovulina* Locard, Ann. Soc. d'Agricult. Lyon (7), iii, 1896, p. 189).

Pupa ischurostoma Bgt., Loc. Subconic, quite wide at base,

almost regularly tapering to the summit; 9 close, subequal, nearly flat whorls, the suture quite marked. Aperture semi-round, sinuated in the upper part, small; 2 superior folds, the longest at the suture, short, very oblique, not callous; 2 small, very unequal, well-immersed columellars; 3 palatals, the first two rudimentary, the third small, attaining the peristome. Peristome rather thin, feebly reflected. Shell thick, red, finely striolate. Length 9, diam. 3 mm. Very rare; plateau of Méaille at Annot (Basses-Alpes). *Pupa ischurostoma* Brgt. in coll., Locard, *t. c.*, 1896, p. 190.

Pupa ebrodunensis Bgt., Loc. Cylindric, a little narrowly lengthened, rapidly tapering at summit; 10 quite close, subequal, very slightly convex whorls, the suture quite marked. Aperture high, narrowly ovate, retreating at base; 2 superior folds, the largest at the suture, straight, thin, the other quite immersed; 2 quite strong, contiguous, immersed columellars; 3 palatals, the superior very short, the second rudimentary, the third only attaining the peristome; peristome reflected, quite thick. Shell solid, red, a little light, with coarse, thin striæ. Alt. 11, diam. 3 mm. Very rare; Embrun (Hautes-Alpes). *Pupa ebrodunensis* Brgt. in coll., Locard, t. c., 1896, p. 190.

Pupa arctespira Bgt., Loc. Narrowly cylindric-elongate, rapidly tapering at the summit; 10 to 11 close whorls, the first convex, the last nearly flat, suture quite marked. Aperture small, straight, semi-round; 2 superior folds, the largest at the suture, a little oblique, somewhat callous, the other contiguous, a little immersed and very arcuate; 2 strong, contiguous columellars, but slightly visible; 4 palatals, the third slender, reaching the peristome, the others rudimentary; peristome reflected, very thick. Shell solid, quite glossy, dark-corneous, very finely striolate. Alt. 10-11, diam. 2¾ mm. Quite rare; Hautes et Basses-Alpes, Var, Drome, Isère, Ain, etc. (*Pupa arctespira* Brgt. in coll., Locard, *t. c.*, 1896, p. 190).

Pupa delphinensis Loc. Large, narrowly and regularly cylindric, shortly tapering at the summit; 12-13 very close, slightly convex whorls, the suture well marked. Aperture small, semi-rounded; 2 subequal superior folds, one at the suture, very arcuate, the second immersed, strong and arcuate; 2 very small columellars, contiguous and well immersed; 4 palatals, the two first quite strong and immersed, the third only attaining the peristome, the fourth rudimentary. Peristome everted, reflected, rather thin. Shell light corneous, very glossy, a little striolate. Height 11-13, diam. 2¾–3 mm. Rare; Sassenage, Corps (Isère), Cassis (Bouches-du-Rhone), etc. *Pupa delphinensis* Locard, t. c., 1896, p. 191.

Pupa plagiostoma Bgt., Loc. Conic-ventricose, slowly tapering above; 7-8 quite convex whorls, the suture impressed. Aperture large, ovate, oblique in one direction; 2 superior folds, the one nearest the suture very small, the other larger, arcuate, immersed; 1 columellar fold, immersed and rudimentary; 2 subequal palatals, the second nearly attaining the peristome. Peristome well expanded, a little thin. Shell corneous-red, but little striate. Alt. 10, diam. 3½ mm. Rare; Méaille near Annot (Basses-Alpes), Saint-Raphael (Var), etc. *Pupa plagiostoma* Brgt. in coll., Locard, t. c., 1896, p. 191.

Var. *sabaudina* Bourguignat (pl. 45, fig. 13, after Bgt.; fig. 15, Lausanne, Switzerland). "Differs from the type by the smaller shell, larger aperture, and the much immersed four palatal plicæ except the third, which alone extends to the peristome." Found in dry, elevated places, under stones, Aix-les-Bains. Has a rather distinct appearance.

Var. *angularis* Westerlund, 1887. Shell cylindric, only conic above, the suture dark-margined. Aperture drawn out below, the peristome reflected, strongly convex, white-lipped. Angular lamella strongly arched above and united with the outer lip. Palatal plicæ 4 (first short, fourth punctiform, second and third marginal, but the second weaker. Length 8–11½, diam. 2½–3½ mm. Poisat, in Dauphiné (*Westerlund*).

A. variabilis obliqua (Nevill). Pl. 45, fig. 14.

Shell related to *P. multidentata* [*A. variabilis*] but of smaller, more compressed form, more cylindric and turrited. Whorls 11, nearly equal, parted by a much impressed suture. Aperture very much contracted, quadrangular, the margins somewhat straight, parallel, and joined by a very strong callosity. Columellar margin distinctly angulate below (in *P. multidentata* rather rounded); parietal lamella less oblique and prominent; columellar lamellæ deeper within; principal [lower] palatal plica conspicuous and noticeable, straightly ascending, hardly curved.

Length 10, diam. 3 mm. Type from deposit *F*.

Length 9½, diam. 3.1 mm. Specimen from deposit *B* (*Nevill*).

Alpes-Maritimes: Menton, in Quaternary deposits. Type in Indian Mus.

Pupa (*Torquilla*) *obliqua* G. Nevill, P. Z. S., 1880, p. 126, pl. 13, f. 4.

A rather rare species, from deposits B. and F only; M. Bourguignat informs me he possesses numerous recent specimens from the "Plateau glacé de Méaille, Dept. Basses-Alpes." I should have ranked this subfossil form as a remarkable dwarf variety of *P. multidentata*, but for the constant and characteristic difference in the prominent palatal fold, which is always more or less semicircularly and markedly curved or rounded in all the forms I know of *P. multidentata;* in my new species this fold ascends the aperture without any deflection or curve whatever; the parietal fold is also distinctly straighter and less prominently produced, the columellar margin not being in the least convex, as well as distinctly angulate at base, seems also a constant character. The present form is nearer the wonderfully produced and turriculate var. *polita* of Risso than typical *P. multidentata* (*Nevill*).

One of the two forms of *variabilis* named by Bourguignat from the plateau of Meaille may be identical with this. Caziot, in his volume on the land and fresh-water mollusks of Monaco (p. 324) notes that it occurs living on the Var and in the Basses-Alpes, at Meailles near Annot, but that it is nothing but an individual variation of the very polymorphic *Pupa variabilis.*

A. variabilis has sometimes been identified with *Turbo multidentatus* Olivi, Zoologia Adriatica, 1792, p. 171, pl. 5, f. 2, said to be found in debris of our coast (the Italian shore of the Adriatic). The figures indicate a shell having 10 or 12 whorls, about 17 mm. long, if of natural size. This agrees better with *A. variabilis polita* of the Riviera than with any other known form. However, as the description and figures are very poor, the name has generally been discarded.

A. variabilis polita (Risso). Pl. 45, fig. 16.

Shell very glossy, shining, translucent, very abruptly terminated above; whorls 12, sculptured with very fine, oblique, somewhat curved striæ; suture deep; epidermis corneous; peristome ivory-white, on the right and posteriorly armed with two lamelliform teeth. Length 14 mm. (*Risso*).

Nice, under stones in ravines (Risso). Maritime Alps from Menton to the Var River.

Clausilia polita Risso, Hist. Nat. Eur. Mérid., iv, 1826, p. 87, pl. 4, f. 36.—*Pupa polita* Risso, Caziot, Étude sur les Moll. terr. et fluv. de la Principauté de Monaco, 1910, p. 323.—*Jaminia multidentata* Risso, *t. c.*, p. 92.

According to Commandant Caziot, this form, which he ranks as a species, differs from *P. variabilis* by the constantly greater dimensions, the number of whorls (12 or 13, instead of 9 or 10), its lengthened shape, the form of the aperture, etc. It is very common in the Alpes-Maritimes, chiefly on low, dry plants.

G. Nevill gives length 19, diam. 4.5 mm., 15 whorls, for an extreme turriculate form from the Hill of Grimaldi, and length 15, diam. 4 mm., for an ordinary form from Roquebrune, 1500 ft. elevation.

Series of A. atracta.

Eastern Alpic center: Dalmatia, Greece.

40. Abida atracta Pils., n. n. Pl. 45, figs. 18, 19.

The shell is subrimate, lengthened, fusiform, very gradually tapering above, the apex rounded, smooth, the rest very finely, obliquely striate; ground-color is yellowish corneous, somewhat darker below. Whorls narrow, a little convex, united by a thread-like, scarcely impressed suture, the last whorl scarcely a fourth of the spire, compressed below, flattened on the neck, the base raised and somewhat tubercular. Aperture rather small, irregularly semiovate, nearly vertical, whitish, having 7 folds: two folds stand on the parietal wall, two rather high ones on the columella, three in the palate, of which the lower two emerge to the lip; all three being visible externally as whitish lines on the neck, and below them an incomplete fourth appears as a whitish fleck on the base. The peristome is white-lipped, the outer margin reflected, columella expanded, forming a small umbilical fissure, terminations of lip joined by a white callous. Length 6, diam. 1⅓ lines (*Kuester*).

Dalmatia: Budoa, on low ground near the sea.

Pupa fusiformis KUESTER, Conchyl. Cab., *Pupa*, p. 83, pl. 12, f. 4, 5; with var. *minor*, p. 84, f. 6, 7; Ber. Nat. Ges. Bamb., ix, 1870, p. 96.—PFEIFFER, Monogr., ii, 340; iii, 546; iv, 672; viii, 382. Not *Pupa fusiformis* C. B. Adams, 1845 (Man. Conch., xvi, 25).

More slender than *cylindracea* Ziegler, with sharper apex, very indistinctly striate, with white-edged suture and only two complete palatal plicæ (*Kuester*).

Var. *puella* n. n. Pl. 45, fig. 17. Less lengthened, with nearly the same width, the aperture somewhat larger, more projecting, rounded, the folds less strongly developed, so that only the third emerges to the lip; the columellar reflection is rather wide, and forms a small umbilical fissure ending in a puncture. Length 4½, diam. 1¼ lines (*Pupa fusiformis* var. *minor Küster*).

As the names *fusiformis* and *minor* are preoccupied in *Pupa*, I have changed both.

41. ABIDA EXIMIA (West.).

Shell obliquely rimate, subfusiform, very lightly obliquely striatulate, glossy, rufous-corneous. Spire slowly tapering from the middle up, with the apex rather acute; suture hair-like, somewhat marginated. Whorls 11-12, the upper smooth, the following a little convex, the last four nearly flat; last whorl slightly ascending in front, subcristate-compressed at the base. Aperture vertical, truncate-oblong; parietal wall having a strong angular lamella and a second lamella, thin and deeply immersed. Columella highly and deeply, equally bidenticulate. Palatal plicæ 3, externally conspicuous, the upper short, the second (usually) and the third (always) emerging to the margin; below them the rudiment of a fourth. Peristome a little expanded, thickly lipped with white or flesh-colored, the margins subparallel, the outer margin usually thickened at the insertion. Length 14, diam. 4½ mm.; aperture with peristome 4 mm. long, 3⅓ wide (*Pfr.*).

Habitat unknown.

Pupa fusiformis var., PFEIFFER, Monogr. Hel. Viv., vi, p.

313, descript. in footnote. — *Pupa eximia* WESTERLUND, Nachrbl. d. m. Ges., vii, 1875, p. 73 (based upon Pfeiffer's description); Synopsis, 1897, p. 91.

42. ABIDA APPELIUSI (Westerlund).

Shell broadly rimate, oblong-conic, the spire long-conic, delicately, regularly striate, corneous-brown; whorls 8½–9, the upper narrow, very slowly increasing, the lower widely although very slowly increasing, rather convex, separated by an impressed suture, the last whorl shortly ascending in front. Aperture oval, somewhat sinuated above towards the right. Angular fold long, doubled externally; parietal fold immersed; 2 columellar lamellæ strong, the upper longer; 4 palatal lamellæ, the first very deep in, the rest long, marginal. Peristome white, thickened, the margins joined by a thin parietal callous. Length 5, width 2 mm. (Westerlund).

Dalmatia (Appelius).

Pupa (*Torquilla*) *appeliusi* WESTERLUND, Verh. zool.-bot. Ges. Wien, xlii, 1892, p. 37; Synopsis, 1897, p. 91.

Pupa fusiformis Kstr. *P. eximia* West. are both 13-14 mm. long, lengthened spindle-shaped forms. Beside them the new form here described is to be placed, with its lengthened-conic shell only 5 mm. long. It differs from *fusiformis*, moreover, by the double number of palatal folds, the smaller number of whorls (8½–9 instead of 13), the lipless margin, etc.; from *eximia* by whorls and margin, strong columellar folds, 4 palatal folds, etc. Perhaps it would be best to make it the type of a new group (*Westerlund*).

43. ABIDA KRUEPERI (Westerlund).

Shell rimate, cylindric, with conic apex, densely striatulate corneous-fulvous; whorls 7½, convex, separated by a slightly impressed, strongly margined suture, the last one slowly ascending in front. Aperture oval, rounded at base, the margins a little arcuate, subparallel, the outer one regularly arcuate above. One rather large median, oblique, immersed parietal fold (the angular fold represented by a small whitish spot in front of the outer lip); columellar folds 2, immersed,

the upper small, lower very small; palatal folds 4, immersed, the two middle ones moderately lengthened, deep within; the first subsutural, punctiform, the fourth below, nodule-like; peristome a little thickened inside, the margins separated, columellar margin slightly expanded. Length 4, diam. 1 mm. (*West.*).

Greece: Kolokytha, in Attica (Th. Krüper).

Pupa (*Torquilla*) *krueperi* WEST., Nachrbl. d. m. Ges., 1894, p. 172.—*Pupa krüperi* WEST., Synopsis, p. 91.

Westerlund says that according to its shape and teeth (the upper and the lower of the palatal folds are very short and deeply placed), this new Grecian species boldly takes its place beside the southwest European *P. brauni* Rm. In the *Synopsis* Westerlund places the species between *appeliusi* and *micheli*.

Series of A. lapidaria.

Species with slowly increasing whorls and strong apertural armature: 2 parietal, 2 columellar and 4 palatals in known species, the *angular lamella small* and short.

I have not seen this species, which resembles *Amphiscopus* by the short angular lamella. Just where it belongs in the series is uncertain, but the reference to *Abida* does not appear plausible. Some forms of *Granopupa* and *Chondrina* have a short angular lamella.

In this connection it may be mentioned that Mr. Ancey expressed the opinion that several species placed by Westerlund in his section *Amphiscopus* (of *Buliminus*), belong to *Abida*. Westerlund himself appears to have been in doubt as to where *Amphiscopus* belongs, remarking that it could also be placed next to *Torquilla* (Fauna, iii, 1887, p. 78), but leaving it as a section of *Buliminus* (p. 55). *Pupa arabica* Dohrn (Malak. Bl., 1859, p. 203) has been placed by Ancey in *Abida* (Journ. de Conchyl., liii, 1905, p. 265), but apparently he had not seen that little-known and still unfigured species.

44. ABIDA(?) LAPIDARIA (Hutton). Pl. 46, fig. 10.

Animal dusky. Shell composed of 7 cylindrical volutions, exclusive of apex; the three first whorls rapidly decreasing

and producing an obtuse spire; the other whorls nearly equal; color brown; finely wrinkled with oblique striæ of growth; aperture ovato-quadrate; lips subreflected, polished and white within; subumbilicate; furnished with eight teeth, two on the pillar within, four on the outer lip within, all of which are visible on the back of the whorl in four pale bands, giving that part a furrowed appearance; and two others on the interrupted part of the peristome, the inner one, which is indeed quite within the aperture, being the largest of all, and the other one small and placed at the angle of the outer lip. Length ¼ inch (*Hutton*).

Shell rimate, subcylindroid, rather thin, obliquely striatulate, brownish-corneous; spire lengthened, obtusely conic at the apex. Whorls 7, convex, the last scarcely one-third the length, somewhat compressed at the base. Aperture vertical, truncate-oblong, 8-toothed: one lamelliform, entering, deeply placed parietal and one minute, nodiform subangular tooth on the parietal wall; two on the columellar; four long teeth, showing outside, in the palate; peristome white, a little expanded. Length 6, diam. 2⅓ mm. (*Pfr.*).

Afghanistan: under stones among blocks of limestone bordering the desert plain of Dusht-i-Be-dowlut at the western end of the Bolan Pass (Hutton).

Pupa lapidaria Hutton, Journal Asiatic Soc. of Bengal, xviii, pt. 2, 1849, p. 652.—Pfeiffer, Monogr. Hel. Viv., iii, p. 546.—Hanley & Theobald, Conch. Indica, p. 40, pl. 100, f. 10.—Sowerby, Conch. Icon., xx, *Pupa*, pl. 16, f. 147; not pl. 4, fig. 32.

It is very closely allied to the English species *Pupa juniperi* (Gray), having the teeth arranged much in the same manner, those of the body whorl giving rise externally to the same furrowed or ribbed appearance. It differs, however, in having only 7 whorls instead of 8 or 9, and in having the largest tooth placed well within the aperture on the middle of the body-whorl (*Hutton*).

Probably the locality is in Baluchistan, or at all events near the border.

Genus GRANOPUPA Boettger.

Granopupa Bttg., Jahrb. Nassauischen Vereins für Naturkunde, Jahrg. 42, 1889, p. 249, monotypic, for *Pupa granum* Drap.

Rupestrella Monterosato, Il Naturalista Siciliano, xiii, June, 1894, p. 170. *Pupa rupestris* Ph. type by virtual tautonymy.

The shell is small, cylindric, conic or turrite, dull brownish or pale brown, thin, striate or ribbed, of 4½ to 6 whorls. Aperture having 0 to 8 teeth, those present arranged as in *Abida*, but *not entering deeply;* angular lamella short or wanting. Lip slightly or not expanded, thin. Columellar axis very slender.

Radula (of *G. rhodia*) having bicuspid lateral teeth with rather wide, squarish basal-plates, long mesocone and distinct ectocone.

Type *G. granum.* Distribution, borders of the Mediterranean and east to Persia; Canary Is.

The radula of *G. granum*, type of the genus, is still unknown; but that of *G. rhodia* has been examined by Prof. Gwatkin and by myself, and proves to be of the type usual in *Pupillidæ*. This removes it from *Chondrina*. The conchological characters differ markedly from *Abida*, and make it expedient to treat the group as of generic rank.

Prof. Boettger proposed *Granopupa* for the species *granum* alone, and in associating the Rupestrellas with it I am assuming that the radulæ will be found similar. So far as the shells are concerned, the genus as here constituted appears natural enough. The species of *Rupestrella* have been associated hitherto with the Chondrinas by all authors who have treated of their affinities, but the dentition is not of the peculiar *Chondrina* type.

Granopupa is more primitive than *Abida* and *Chondrina;* quite possibly both of these genera arose from Granopupid ancestors. The connection existing between European genera and the South African *Fauxulus* was probably through a common ancestral stock resembling the relatively unspecialized *Granopupæ*, since the details of tooth specialization differ in

the more advanced forms of the two areas, though the homology of the principal teeth is obvious.

Distribution of Granopupa.

In its mode of life, which is essentially that of *Pupilla* and many Vertigos, *Granopupa granum* has invaded a new station (or perhaps more properly, it has remained in the primitive station of its ancestors); this allowed it to spread more widely than the allied genus *Abida*, which is confined for the most part to rocky or mountainous and usually limestone districts, where they live on cliffs and rocks, like *Clausilia*. No fossil forms of *Granopupa* are known, but its presence from the Canaries to Persia indicates considerable antiquity.

The subgenus *Rupestrella* is less widely spread, though some species such as *rhodia* and especially *philippii* have wide ranges. The species inhabit the borders of the Mediterranean, Adriatic, Aegean and Black seas from Bougie in Algeria to Armenia. The Algerian group was evidently derived from that of Italy and Sicily by way of a former land bridge separating the eastern and western basins of the Mediterranean. In Europe, none are found west of Italy; France and Spain being without species of *Rupestrella*. Ct. Caziot considers it a group of the southern Alpic center, but beyond limiting its northward spread locally, it may be doubted whether the Alps had anything to do with the evolution of the group. They are not mountain snails.

Key to Species of Granopupa.

a^1. Four palatal folds, in all 7 or 8 teeth. *granum*, no. 1.

a^2. Two palatal folds.

b^1. Distinctly conic, diam. fully half the alt.; 6–8 teeth, 6½–7 whorls. Dalmatia.
Chondrina spelta, Vol. XXV.

b^2. Oblong-conic or fusiform, more slender; 4–6 teeth.

c^1. European species, Italy to Greece, Crimea, and Asia Minor.

d^1. A parietal and usually an angular lam., 1 or 2 columellars, 2 palatal folds.
nitida, no. 3; *philippii*, no. 2.

d^2. No lamellæ on parietal wall; spire more slender. *rhodia*, no. 4.

c^2. North African species; 6 teeth.

d^1. Rib-striate; 5⅓ to 6½ mm., 7 whorls. Algeria. *michaudi*, no. 5.

d^2. Elegantly costulate; 5 x 2¾ mm., 7 whorls. Algeria. *kabyliana*, no. 7.

d^3. Striatulate; 4 x 1½ mm., 5½ whorls. Tunis. *punica*, no. 9.

a^3. One palatal fold or none.

b^1. Aperture toothless.

c^1. Algerian species; length about 4 mm.

d^1. 4½ whorls. *dupoteti*, no. 11.

d^2. 6 whorls. *eucyphogyra*, no. 12.

c^2. Sicilian species.

d^1. Rib-striate; whorls very convex. *rupestris*, no. 13.

d^2. Obsoletely costulate; whorls less convex. *homala*, no. 14.

c^3. Species of the Pyrenees and eastern Spain. *Chondrina farinesii*, Vol. XXV.

b^2. Aperture with 1 to 3 teeth; no angular lamella; Sicily.

c^1. Whorls extremely convex, scalariform, coarsely ribbed; columellar lamella present, sometimes parietal and palatal also. *scalaris*, no. 16.

c^2. Penult whorl very convex; coarsely ribbed; a col. lam., sometimes also parietal and palatal. *refuga*, no. 17.

c^3. Whorls not extremely convex, rib-striate; single parietal, columellar and palatal teeth. *occulta*, no. 15.

b^3. Aperture with 1 to 4 teeth. North Africa.

c^1. Striatulate; 4 x 2 mm., 5½ whorls. Tunis. *barratti*, no. 10.

c^2. Costulate or rib-striate; about 5 x 2 mm., 6 whorls. Algeria. *brondeli*, no. 6. *cartennensis*, no. 8.

Subgenus GRANOPUPA Boettger.

Shell small, cylindric or somewhat conic, with 7 or 8 immersed but not deeply entering teeth arranged as in *Abida* and *Chondrina;* the angular, spiral and subcolumellar lamellæ and suprapalatal and basal plicæ are small or often wanting, the parietal and lower palatal being the largest teeth. Columellar axis slender. Type *Pupa granum* Drap.

Distribution: Mediterranean region and east to Persia; Canary Islands. Living at roots of grass and under stones.

In proposing *Granopupa* as a genus, Dr. Boettger did not define it, but remarked that the little group of *P. granum* is so different from *Torquilla* in size, structure of the mouth and apertural folds, and especially in habits, that it must be eliminated from that genus; its peculiar geographic distribution alone sufficiently demonstrates its broad distinction from the true Torquillas.

1. GRANOPUPA GRANUM (Drap.). Pl. 47, figs. 3, 12.

The shell is rimate, cylindric, the upper third tapering to the obtuse apex, of a cinnamon color, fading at the summit; delicately, rather closely rib-striate. Whorls convex, the last rounded beneath, not ascending in front. Aperture truncate-oval, with 1–2–4 teeth. Parietal lamella high, rather short, deeply placed; columellar and subcolumellar lamellæ small, short, deep within; lower palatal plica rather long, high in the middle, the upper palatal, suprapalatal and basal smaller; all remote from the peristome. Peristome thin, the columellar margin dilated, other margins scarcely expanded.

Length 4.5, diam. 1.6 mm.; 7½ whorls.

Length 4.8, diam. 1.7 mm.; 7½ whorls.

Length 3.5, diam. 1.5 mm.; 6½ whorls.

Throughout southern Europe from Portugal eastward, north to Switzerland; Sicily, Malta and the islands of Greece. Asia Minor, Caucasus, Transcaspian Territory and northern Persia; Arabia. North Africa from Tunis to Morocco; Canary Islands. Lives at the roots of shrubs and grass and under stones.

Pupa granum DRAPARNAUD, Tabl., 1801, p. 59; Hist. Moll.

Fr., p. 63, pl. 3, f. 45, 46. — Rossmaessler, Iconogr., i, pt. 5, p. 14, f. 322; pt. 11, p. 11, f. 730. — Moquin-Tandon, Moll. France, p. 370, pl. 26, f. 34-38. — Pfeiffer, Monogr., ii, 343; iii, 547; iv, 673; vi, 314; viii, 383 (see for earlier references).— Westerlund, Fauna, iii, 1887, p. 119, with forms *minor* and *tetrodon* West., p. 120. — Morelet, Journ. de Conch., 1880, p. 60 (Medit. litoral of Morocco).—Naegele, Nachrbl., 1902, p. 7 (Adana, Cilicia).—Smith, Journ. Linn. Soc. Lond., Zool., vol. 27, p. 393 (Koyun Daghi, Lake Urmi, Persia).—Nobre, Annaes Scientif. Acad. Polytech. Porto, iii, 1908, p. 52, pl. 1, f. 6 (dist. and variation in Portugal).—Benoit, Nuovo Catalogo Conch. terr. e fluv. Sicilia, 1881, p. 94 (many Sicilian localities). — Letourneux and Bourguignat, Prodr. Malac. Tunisie, 1887, p. 108 (common in Tunis). — Bourguignat, Malacologie de l'Algerie, ii, 1864, p. 84, pl. 6, f. 1-3, with var. *minor* (many localities throughout Algeria).—Kuester, 9ter Bericht Nat. Ges. Bamberg, 1870, p. 97 (everywhere in Dalmatia, very variable in size, the smaller ones more conic, the larger, up to 5 mm. long, cylindric). — *Granopupa granum* Drap., Boettger, Jahrb. d. Malak. Ges., vi, 1879, p. 399 (Transcaspia); Nachrbl. d. Malak. Ges., vol. 39, 1907, p. 39 (Islands of Corfu, Euboea, Crete, Syra, Thasos; Pelion Mts., Thessaly; Asia Minor); Zoologische Jahrb., iv, 1889, p. 957 (Krasnowodsk and high on the Great Balchan, Transcaspia; Shah-rud, Prov. Irak Adschmi, Persia; Adalia, Lycia; Brumana, Syria; Transcaucasus; Russian Armenia, etc.).—Westerlund, Synopsis, 1897, p. 105, with varr. *diluta, subulata, poulseni.—Abida* (*Granopupa*) *granum* Dr., Ancey, Journ. de Conchyl., liii, 1905, p. 264 (Djeddah, Arabia).

Pupa graniformis "Draparnaud," Locard, Ann. Soc. d'Agricult. Lyon (7), iii, 1896, p. 208, f. 446-7; n. n. for *granum* Drap.

Pupa aemula Parr. Mss., Martens, Malak. Bl., xx, 1872, p. 49, pl. 3, f. 6.

Pupa saulcyi Bourguignat, Test. nov., etc., 1852, p. 19; Catal. Raisonné Moll. terr. et fluv. rec. par Saulcy, 1853, p. 53, pl. 2, f. 22, 23 (under stones, Nabi-Younes, Syria).

Pupa granum var. *meridionalis* Adami, Bull. Soc. Malac. Ital., xi, 1885, p. 222.

Pupa granum var. *bulimiformis* Love MS., Mousson, Révision de la Fauna Malacologique des Canaries, 1872, p. 123. —*Pupa granum* var. *bulimæformis* Wollaston, Testacea Atlantica, 1878, pp. 451-2.

P.[*upa*] (*Torquilla*) *profuga* Westerlund, Ann. Mus. Zool. Acad. Imp. Sci. St. Pétersb., iii, 1898, p. 165.—Lindholm, same Annuaire, xviii, 1913, p. 159, as a synonym of *Pupa granum*.

The typical form of *granum* has seven teeth, as described above. In some localities a minute angular lamella is added, and there may be also a little spiral lamella outside of the inner end of the parietal and not visible in a direct front view, as shown in pl. 47, fig. 12, from Tuscany.

In specimens seen from Greece and Asia Minor the little suprapalatal plica is often wanting, and the angular nodule frequently rather conspicuous.

Having seen many specimens labeled *P. subulata* by Benoit, I am unable to find any constant differences. The specimens from Malta, from A. Caruana-Gatto, are ordinary *granum*.

In most localities there is considerable variation in size and degree of taper. Sometimes the striæ are partly effaced on the later whorls. The named varieties are partly selected specimens from variable lots, and none of them appear to have much racial value.

The Transcaspian *P. profuga* West. is said by Lindholm, who examined the type lot, not to differ even varietally from *granum*. The description follows:

P[*upa*] (*Torquilla*) *profuga* West. Shell rimate, cylindric-turrited, buff, densely hair-striate under a strong lens, the striæ oblique and curved. 7½–8 slowly increasing, rather convex whorls, the last ascending in front, dilated, rotund at base. Suture a little oblique. Aperture oval, 7-toothed: one parietal, two columellar, four palatal; and an obsolete angular denticle; parietal lamella immersed, high; columellar teeth immersed, short, the lower one smaller; palatal plicæ immersed, the first very short, fourth punctiform, second and third short (the third longer), tubercular in the middle, but prolonged inward in a long, thin tail. Peristome everywhere equally spreading, whitish, the margins slightly curved, con-

verging, and joined by a very thin callous. Length 5½–6, diam. 1½ mm.

Krassnovodsk, Transcaspian Province (A. Kasnakow), in Zool. Mus. Petrograd (WESTERLUND, Ann. du Musée Zoologique de l'Acad. Imp. Sci. de St. Pétersb., iii, 1898, p. 165).

Var. *turbiana* Caziot. Form stouter, more ventricose. Under stones between la Turbie and Notre-Dame de Laghet (*Pupa granum* var. *turbiana* Caziot, Etude Moll. t. et fl. Monaco et Dép. Alpes-Marit., 1910, p. 322).

Var. *diluta* West. Shell whitish or buff, the whorls convex, the last narrower posteriorly, aperture more oblong, three upper palatal plicæ, especially the first and second, long, but the lower (fourth) one short. Grasse, France. ([*Pupa granum*] var. *diluta* West., Fauna Europæa, ii, 1878, p. 177.)

Var. *meridionalis* Adami, from debris of a stream flowing into the sea at Noicataro near Bari, Trentino, appears to differ from *granum* only by the reduction of the teeth to five, there being but two palatals, though the shape is said to be a little less tapering, and the ends of the lip distant, not converging.

Var. *aemula* 'Parr.' Martens. Shell rimate, ovate-oblong, lightly striate, glossy, pale corneous; the spire somewhat obtuse; whorls 6½, a little convex, the suture not deep, last whorl rounded at base; aperture oval, 5-plicate; no angular fold; parietal immersed, compressed, strong; columellar tooth-like; three palatal plicæ, the upper very short, lower very long; peristome simple, a little expanded, the margins converging. Length 3⅔, diam. scarcely 1½, aperture 1⅙ mm. Athens, E. Raymond. Dalmatia according to Parreyss. When one looks as deeply as possible into the aperture another smaller columellar tooth often becomes visible below the first one (*Martens*).

Form *tetrodon* West. Aperture with only 4 folds, a parietal, 2 columellars, the lower scarcely noticeable, 1 palatal. Piraeus (*Westerlund*).

Pupa saulcyi Bgt., of Syria, was described and figured as having 6 little teeth: a small angular tooth, two parietals, of which one is wholly immersed, and three palatals. No columellar teeth are mentioned or figured, but the presence of one

or two, deeply immersed, may be suspected. It is 4 mm. long, 2 wide. Since the shell agrees with *granum* except as to the columella, it has been placed in the synonymy of that species by Pfeiffer and others. Bourguignat's figure is copied, pl. 46, fig. 4.

Var. *sardoa* (Cantraine). In form and size it resembles *P. philippii* and *occulta*. It is nearly cylindric, a little conic, marked with spaced striæ nearly resembling little ribs; the color is corneous-brown. The whorls of the spire are quite convex, as in the preceding species [*frumentum*]. As to the aperture, it is semi-oval and furnished with five folds, of which one is on the columella, three on the lip, of which the lower one is the strongest, and it alone merits the term of fold, the two others resembling teeth; they are shown on the outside as white marks; the fifth fold is placed on the convexity of the penult whorl. They are all quite immersed within the aperture. The umbilical crevice is quite open, and the peristome is simple or slightly reflected. Alt. 2, diam. 2/3 lines; 7 whorls. Sardinia (*Cantraine*).

P.[*upa*] *sardoa* CANTRAINE, Malacologie Méditerranéenne et Littorale, 1840 (Mém. Acad. Roy. Bruxelles), p. 142, pl. 13, f. 6.

I do not know that the plate referred to by Cantraine was ever published, as the copy of Malacologie Méditerranéenne before me has only six plates.

M. Margier (or at least "E. M.") writes that he was "so fortunate as to find two examples which correspond remarkably well with Cantraine's description of *P. sardoa*, among specimens of *Pupa granum* from the environs of Caglieri, sent by M. le Marquis de Monterosato. *P. sardoa* belongs incontestably to the group of *P. granum* Drap. It differs from the latter by the shape, which resembles that of *P. subulata* Biv. of Sicily, and by the number of palatal teeth (only three), while *P. granum* has four. It appears to be simply a variety of Draparnaud's species, well known and widely spread throughout Mediterranean lands. The *P. subulata* Biv. should not be kept as a species, it appears to us, but as a variety of *P. granum.*" (*E. M.* in Feuille des Jeunes Naturalistes, Dec. 1902, no. 386, p. 35.)

Var. *subulata* (Bivona). Shell shortly rimate, cylindric-ovate, very finely rib-striate, silky, corneous; spire gradually tapering, the apex rather acute; 6-7 convex whorls, the last narrower; aperture somewhat rounded, 8-folded: 1 parietal, 2 tooth-like columellars, about 5 unequal palatals; peristome simple, slightly expanded, the margins approaching. Length 4, diam. 1⅔, apert. 1¼ x 1 mm. (*Pfr.*). Sicily: near Palermo on the Oreto river, and near Cefalu, *Benoit*.

Pupa subulata Bivona, Monogr. Moll. Palermo, 1840, p. 11. —Philippi, Zeitsch. f. Malak., 1844, p. 105.—Kuester, Syst. Conch. Cab., p. 94, pl. 13, f. 5, 6.—Pfr., Monogr., ii, p. 343.—Benoit, Nuovo Catalogo Conch. t. e fl. Sicilia, 1881, p. 94.

Philippi notes that this species is very like *P. granum*, but not so elongate and easy to distinguish by the larger number of palatal folds [5]. In one example there is an indication of a tubercle at the insertion of the outer lip.

Var. *poulseni* West. Cylindric, with conic and very obtuse apex; whorls 7, strongly convex, with very deep suture, the last whorl not so wide as the penult, elongate-convex behind, slowly and highly ascending above. Aperture oval-rounded, with 7 lamellæ and plicæ: 1 parietal lamella and a diminutive little angular tubercle; 2 deeply placed columellars, 4 short palatals. Columellar margin straightened, the outer margin strongly arched above. Length 4, diam. 1½ mm. Sicily, on the Simito river near Catania, Dr. Poulsen ([*Pupa subulata*] var. *poulseni Westerlund*, Fauna, iii, 1887, p. 120).

Var. *minor* Bgt. Smaller, 3¾ x 2 mm., with shorter, more acuminate spire of slightly more convex whorls; found here and there with the typical form in Algeria (*Pupa granum* var. B. *minor* Bourguignat, Malac. de l'Algerie, ii, 1864, p. 86).

Var. *bulimiformis* 'Lowe' Mouss. Smaller, 4–4½ mm. long, 1½–1¾ diam., thinner, subpellucid, pale corneous, scarcely rib-striate. Canary Is., between Maspalomas and Juan Grande, Grand Canary; Sta. Maria Betencouria, Fuerteventura; below Haria, Lanzarote; under stones in arid places, collected by Wollaston (*Mousson*).

Section *Rupestrella* Monts.

Slender Granopupæ with the lamellæ and plicæ small, often wanting wholly or in part; palatal plicæ 0 to 2; peristome thin, with slight expansion or none. Shell generally daubed with dirt.

Type *Pupa rupestris* Ph. Distribution, Italy and Sicily eastward to Asia Minor, and in Tunis and Algeria.

Westerlund and Caziot have distributed these forms among several successive groups, natural enough, yet very closely connected. The series is a complex of related forms showing various stages in tooth-reduction, culminating in wholly toothless species. This series is parallel to the *Chondrina farinesii* series of Spain, though of course of quite different genesis, the *farinesii* series being apparently derived from the *C. avenacea* group.

Species of Sicily, Italy, Dalmatia, Greece and Asia Minor.

2. GRANOPUPA PHILIPPII (Cantraine). Pl. 48, figs. 12, 13, 14.

The shell is shortly, deeply rimate, oblong-conic, russet, finely rib-striate, the striæ usually somewhat irregular. First whorl large, projecting, retuse at apex, very minutely granulose; following whorls strongly convex, the penult somewhat swollen, last whorl somewhat flattened behind the lip, not ascending. Aperture oblong. Angular lamella very small and short, parietal much larger though small; columellar lamella equal to the parietal and equally immersed, subcolumellar very minute; palatal plicæ two, the upper much larger, not reaching the peristome, the lower less emerging [and sometimes wanting]. Peristome thin, whitish, the outer margin scarcely expanded, columellar margin broadly triangularly dilated; the margins approach, and are joined by a thin, transparent parietal callous.

Length 4, diam. 1.6 mm.; 5¾ whorls (Capri).

Length 3.9 to 4.2, diam. 1.8 mm. (Prevesa).

Sicily: environs of Palermo (Benoit); Taormina, near Siracusa (Benoit, J. L. Baily). Italy: Capri; around Naples (Philippi); Scala d'Anacapri (Bellini); Calabria; Abruzzo; Tuscany; Pisa (Charp.); Sardinia (Cantraine); Apuan Alps.

Dalmatia. Albania. Montenegro. Greece: Corfu; Prevesa; Epirus; Thessaly; Attica; Euboea; Leros Is.; Kalymnos; Zante; Rhodes. Armenia (Pfr., Westerlund).

Pupa philippii CANTRAINE, Malac. Med. et Litt., 1841, p. 140.—PHILIPPI, Emum. Moll. Sicil., ii, 1844, p. 114, pl. 21, f. 3 (copied from Rossmaessler).—PFR., Monogr., ii, 350; iii, 548; iv, 674; vi, 348; viii, 387.—MOUSSON, Coq. terr. et fluv. rec. dans l'Orient par A. Schlaefli, p. 11, with var. *exigua*, p. 12 (in Vierteljahrsschrift Naturforsch. Ges. Zurich, iv, 1859).—BELLINI, Boll. Soc. di Naturalisti in Napoli, xxvii, 1915, p. 178.—CAZIOT, Bull. Soc. Zool. France, xxxv, 1910, p. 147 (discussion of synonymy).—BENOIT, Nuovo Catal. Conch. Sicilia, 1881, p. 96.—*Pupa caprearum* Philippi *in litt.*, ROSSMAESSLER, Iconogr., ii, pt. xi, 1842, p. 11, pl. 53, f. 729.—KUESTER, Conchyl. Cab., p. 32, pl. 4, f. 14-16.—*Pupa nana* M. von Mühlfeld in coll., never described; re-named *Torquilla humilis* BECK, Index Moll., 1837, p. 85, no description.—*Pupa savii* Charp., *in litt.* (as synonym of *caprearum*), ROSSM., Iconogr., ii, pt. xi, p. 11 (specimens from wall of Pisa near the Battisterio on the Arno).—*P. sawii* Char., MOUSSON, Coq. Schlaefli, 1859, p. 11, as syn. of *P. philippii*.

Form *major* West. Length to 5½ mm. Armenia (*Westerlund*, Synopsis, 1897, p. 105).

Var. *exigua* Mousson. Smaller, not exceeding 3–3½ mm., dull violaceous corneous, whorls 3–3½, palatal teeth very minute. It approaches most to the specimens of Attica. Corfu (*Mouss.*). Hesse found similar examples at the foot of Hymettos, Athens (Jahrb. d. m. Ges., ix, 333).

Hesse, writing of Grecian specimens, says that "the dentition is extraordinarily variable. In all examples except the small ones from Athens, I observed the angular lamella. Those from Lykabettos (near Athens) and from Prevesa have only one tooth on the columella, those from Hymettos and also Corfu have always two, of which the lower is sometimes rudimentary but always perceptible. Of the Epirotic examples one has two columellar teeth, and between the upper one and the parietal lamella, two other little denticles" (Jahrb. d. mal. Ges., ix, 1882, p. 333).

Commandant Caziot mentions Majorca among the localities for *philippii*, but if living there, I suspect that it was imported from Italy.

This widely distributed species has the spire less attenuate above than in *rhodia*, and there is usually an angular lamella.

3. GRANOPUPA NITIDA ('Fér.' Küster). Pl. 48, fig. 3.

The shell is small, with a short, rather widened umbilical crevice, fusiform, obtuse, very finely rib-striate, very glossy, reddish horn-brown, strongly translucent, thin. The 6 whorls are strongly convex, separated by a very deep suture, the first wart-like, the rest increasing in height rather rapidly, the penult almost wider than the last. The neck is hardly flattened, with two whitish spots, the base but little compressed. Aperture large, rounded, higher than wide, almost rounded quadrangular, rust-yellow, with 4 folds, one each on the columella and deep in the parietal wall, 2 very unequal on the palate, the upper long and rather strong, the lower remote and punctiform. Peristome acute, but little expanded, without lip, angularly produced above, the margins much converging. Length 2¼, diam. ¾ line (*Kuester*).

Switzerland (Anton).

Pupa nitida Fér. ANTON, Verzeichniss der Conchylien Sammlung Anton, 1839, p. 47, no. 1714 (nude name).—KUESTER, Conchyl. Cab., p. 50, pl. 6, f. 17, 18.—PFR., Monogr., ii, 335.

A lost species. Possibly it may be a rather large *philippii* without an angular lamella; yet as that form and its allies had been worked over carefully by Küster (C. Cab., pp. 32, 33), one would expect a recognition of that well-known species from him. The locality given by Anton was probably wrong, as the shells of Switzerland are rather well known, and no subsequent author has recognized *nitida* so far as I know. It has also some resemblance to *spelta* Bk., particularly to the var. *obscura*. This is not "*Pupa nitida Antonelli*" of Sowerby, Conch. Iconica, xx, pl. 17, fig. 174. His figure looks like *Columella edentula* (Drap.).

4. GRANOPUPA RHODIA (Roth). Pl. 48, fig. 15.

The shell is subperforate and rimate, slender, turrited, rather closely rib-striate, cinnamon-brown. Spire attenuate, with slightly concave outlines in the upper part. First whorl large, obtuse, most minutely granulose. Whorls strongly convex, the penult rather swollen, last whorl rounded at base and slightly impressed over the upper palatal plica. Aperture oblong, brownish within with white teeth. There is no angular lamella; parietal lamella short and rather high, the columellar lamella equal to it; subcolumellar much smaller and shorter. Two palatal plicæ, the upper rather long, and weakly reaching the peristome, the lower smaller, shorter. Peristome thin, white, the outer margin scarcely expanded, columellar margin dilated; parietal callous thin and transparent. Length 4.5, diam. including peristome 1.8 mm.; 6½ whorls.

Dalmatia; Montenegro; Kephalonia; Euboea; Rhodes; Adana in Asia Minor; Beirut, Syria; southern Crimea at Jalta and Sadah.

Pupa rhodia ROTH, Moll. Species quas in Iter. per Orient. Schuberti, Erde et Roth: Dissert. Inaug., 1839, p. 19, pl. 2, f. 4.—KUESTER, Conchyl. Cab., p. 31, pl. 4, f. 11.—PFR., Monogr., ii, 350; iii, 548; iv, 674; vi, 318.—ROSSMAESSLER, Iconogr., iii, 1859, p. 108, pl. 85, f. 940.—MOUSSON, Coq. terr. et fluv. rec. par Roth, 1861, p. 50 (around Jerusalem).—WESTERLUND, Malak. Bl., xxii, p. 123; Synopsis, 1897, p. 105, with var. *taurica* Kessler.—CAZIOT, Bull. Soc. Zool. France, xxxv, 1910, p. 150 (synonymy).—*Pupa acuta* Kutschig MS., and *Pupa acutula* Parreyss MS., according to ROSSMAESSLER, Iconogr., iii, 17-18 Heft, 1859, p. 108.—*Pupa meledana* Stentz MS., quoted without description as a synonym of *Torquilla occulta* Parr., by A. et J. B. VILLA, Disp. Syst. Conch., etc., 1841, p. 24.

A strongly sculptured species, with the spire very slender above, and having no angular lamella.

The undescribed *Pupa meledana* Stentz would be a synonym of *occulta* according to the record, since it was first mentioned in that connection; yet as the name is obviously from the island Meleda near Ragusa (far from the habitat of *occulta*

and within that of *rhodia*), Com. Caziot has transferred it to the synonymy of *rhodia*.

Var. *taurica* Kessler. Shell larger, the palatal plicæ subequal. Length up to 5, diam. 2.1 mm. Tauria. (Reise nach d. Krim, 1860.)

African Species.

5. GRANOPUPA MICHAUDI (Terver). Pl. 47, fig. 1.

The shell is obliquely rimate, subperforate, *slender, regularly tapering* from the last whorl to the obtuse apex, cinnamon-brown. First whorl is minutely granular, the rest obliquely rib-striate. All the whorls are rather strongly convex, regularly increasing, the last somewhat compressed and tapering to the narrowly rounded base, the suture scarcely or not ascending to the lip. The aperture is slightly oblique, oblong, brown within, with whitish teeth and margin. The angular lamella is rather short; no spiral lamella; parietal lamella longer. Columella lamella subhorizontal, not emerging to the peristome in front, obliquely ascending to a dorsal position inwardly; subcolumellar lamella smaller and shorter. The small upper and lower palatal plicæ do not reach the lip; both are short, but the upper somewhat longer. Peristome is thin, the outer lip and columellar margins subparallel, outer very slightly expanded, strongly arched above, columellar expanded; terminations approach and are joined by a scarcely perceptible, transparent callous, which is corrugated by the striæ.

Length 6.3, diam. including lip 1.8 mm.; 7⅓ whorls.

Length 5.3 mm.; 7 whorls.

Algeria: Bougie, on the ridges of Gourayah, a mountain of about 700 meters elevation, on rocks exposed to the east (Dupotet, Terver); near Constantine on the peak of Bou-Mécid (Raymond, Brondel). Gorges of the Isser; Ait Ouaban in the Jurjura (Letourneux).

Pupa michaudii TERVER, Catal. Moll. nord d'Afrique, 1839, p. 31, pl. 4, f. 12.—ROSSMAESSLER, Iconogr., ii, pt. x, p. 25, pl. 49, f. 640; and in Wagner, Reisen in der Regentsch. Algier, ii, 1841, p. 250.—KUESTER, C. Cab., p. 30, pl. 4, f. 8-10.—PFR.,

Monogr., ii, p. 349.—Morelet, Journ. de Conchyl., iv, 1853, p. 292.—Bourguignat, Malac. d'Algérie, ii, 1864, p. 87, pl. 5, f. 39-42.—Letourneux, La Kabylie et les coutumes Kabyles, 1872, p. 227.

There are sometimes small accessory tubercles in the subparietal position and between columellar and subcolumellar lamellæ. The figure is from a specimen received from Terver.

The animal is black or deep gray, its tentacles long, rounded at the summits, lower tentacles extremely short, only appearing as black dots (*Terver*).

5*a*. *Granopupa michaudi isseriana* n. subsp. Pl. 47, fig. 2.

Resembling *michaudi*, but of stouter, more conic figure, with finer striation and larger aperture, and the palatal plicæ and columellar lamella emerge less. Length 6.5, diam. 2.2 mm.

Gorge de Palestro, Kabylia. Type no. 75906 A. N. S. P., from C. F. Ancey.

Pupa michaudi var. *isserica* Ancey in coll., not *Pupa isserica* Letourneux, 1870.

6. Granopupa brondeli (Bourg.). Pl. 47, figs. 4, 5.

Shell subperforate-rimate, very long conic, slender, subpellucid, fulvous, and elegantly costulate. Spire subulate-acuminate, the apex paler, smooth, obtuse. Whorls 6, convex, regularly increasing, separated by a deep suture, the last a little larger, rounded at base, slightly sinuated at the outer lip, and slightly ascending to the insertion of the outer lip. Aperture rather oblique, lunate-rotund, biplicate: one parietal and one columellar fold. Peristome thin, a little expanded, the columellar margin somewhat reflected; margins converging and approximate. Length 5, diam. 2 mm. (*Bgt.*).

Algeria: Pescade point (Péraudière, Brondel, *et al.*); debris of the Harrach (Letourneux) and grounds of the Maison-Carrée (Lallemant).

Pupa brondeli Bourguignat, Malac. de l'Algérie, ii, 1864, p. 88, pl. 5, f. 43-46.

Pupa brondeli differs from *michaudi*, the only species with which it could be confounded, by the smaller shell which is

less lanceolate, more conic, by the stronger, more widely spaced riblets, and especially by the oblique aperture, having only one columellar and one parietal fold (*Bgt.*).

Specimens in coll. A. N. S., apparently referable to *brondeli*, vary in the teeth as follows: one columellar lamella only; columellar and parietal lamellæ; columellar, parietal and angular lamellæ, and a weak upper palatal plica, the latter brown like the shell (pl. 47, fig. 4). Length 5, diam. 2.2 mm.

7. GRANOPUPA KABYLIANA (Let.). Pl. 47, fig. 10.

Shell rimate-perforate, fusiform, subpellucid, corneous throughout, elegantly, sharply and obliquely costulate. Spire long, tapering, at the apex obtuse, glossy, smooth, mamillate. Whorls 7, convexly rounded, regularly and rather rapidly increasing, separated by a deep suture, the penult. large, swollen, the last smaller, descending at the aperture. Aperture slightly oblique, lunate, semi-oblong, six-toothed, as follows: two teeth on the convexity of the penult whorl, one median, deeply placed, stronger, the other smaller, at the insertion of the lip; two on the columella, one stronger, above, the other smaller; two palatal, immersed, lamelliform. Peristome acute, slightly expanded, a little labiate within; outer margin straight towards the insertion of the lip; columella straight, expanded. Length 5, diam. 2¾ mm. (*Let.*).

Algeria: Rocks of Tablabalt near Fort Napoleon; Azeron des Ait-Zikki (Kabylie du Jurjura). Chabet-el-Akra (Kabylie des Babors).

Pupa kabyliana LETOURNEUX, Ann. de Malacol., i, 1870, p. 309; La Kabylie, 1872, p. 227.

It is a shorter, more conic shall than *michaudi*, with decidedly finer striation. The figured specimen from the Jurjura Mts. at 3000 ft., was received from Ancey, and measures, length 5.3, diam. 2.1 mm.; 6¾ whorls. The apical whorl is like that of *michaudi*.

8. GRANOPUPA CARTENNENSIS ('Let.' Ancey).

Shell elongate-oblong, perforate, slightly shining, dark vinous-brown, coarsely rib-striate except at the summit. Spire

oblong-tapering, the summit somewhat obtuse. Six convex, regularly increasing whorls, the suture impressed, last whorl oblong, somewhat tapering. Aperture oblong, subangular above, wholly toothless except for a columellar denticle. Peristome expanded a little, somewhat dilated at the columella. Length 5, diam. 1¾ mm., aperture scarcely 1½ mm. high (*Ancey*).

Algeria: mountain of the Cape of Ténès (Cartenna), in the dép. d'Alger (Letourneux).

Pupa cartennensis Letourneux MS., Ancey, Bull. Soc. Zool. de France, vol. 18, 1893, p. 138.

"This interesting species belongs to the group of *Pupa michaudi* of Terver. It is quite unlike all of its congeners, from which it may be distinguished without difficulty by the characters of the aperture. This is not toothless, as has been affirmed by MM. Letourneux et Bourguignat in their *Prodrome de la Malacologie terrestre et fluviatile de la Tunisie*, but provided with a single columellar denticle" (*Ancey*).

This species was mentioned incidentally by Letourneux and Bourguignat under their description of *Pupa punica, q. v.*

9. Granopupa punica (Let. et Bgt.).

Shell minute, rimate (the rima half covered), oblong, slightly fusiform, tapering above and below, a little swollen in the middle, rather fragile, subdiaphanous, corneous-chestnut, obliquely striatulate; spire oblong, obtusely tapering, the apex large, obtuse, having a mamillate appearance; whorls 5½, having a twisted appearance, rounded, regularly increasing, separated by a deep suture, the last of moderate size, a little convex, slightly flattened near the peristome outside, tapering below, straightened above at the insertion. Aperture oblique, subovate, 6-lamellate, as follows: 2 parietal lamellæ, one minute at the insertion, the other median, more deeply placed; 2 columellar lamellæ, the lower one very minute; and 2 palatals, rather remote, and not reaching the margin. Peristome whitish, acute, lightly spreading throughout; columellar margin dilated in triangular form and expanded above the umbilical crevice; margins strongly approaching. Alt. 4, diam. 1½ mm. (*L. & B.*).

Tunis: on damp rocks near the spring, Djebel Zaghouan (Let.).

Pupa punica LETOURNEUX et BOURGUIGNAT, Prodrome de la Malacologie terr. et fluv. de Tunisie, 1887, p. 107.

This species, of the series of *Pupa avenacea*, is distinct from all the Pupas of this series. It is not without points of resemblance in size and form with *P. cartennensis* (Letourneux, 1884) of the mountain of Tenez, in Algeria; but that has a wholly toothless aperture (*L. & B.*).

10. GRANOPUPA BARATTEI (Let. et Bgt.).

Shell minute, narrowly perforate; oblong-subconoid, not tapering downward, but stouter, ventricose; fragile, subdiaphanous, corneous; obliquely striatulate. Spire long, regularly tapering but obtuse at the summit, the apex very obtuse, large, flattened above. Whorls 5½, rounded, regularly increasing, separated by a deep suture, the last whorl convex, rounded below, straightened at the insertion. Aperture oblique, subovate, four-lamellate as follows: two punctiform parietal lamellæ, of which the upper is at the insertion, the lower deeply placed and median; one columellar lamella, above, denticle-like; palatal lamella also single, very obsolete. Peristome paler, fragile, spreading throughout; columellar margin dilated and expanded; margins approaching. Alt. 4, diam. 2 mm. (*L. & B.*).

Tunis: in crevices of the rocks, Djebel Bou-Kournein (Let.).

Pupa barattei LETOURNEUX et BOURGUIGNAT, Prodr. Malac. Tunisie, 1887, p. 108.

This Pupa, of the same series as the preceding, is distinguished from that not only by the denticles of the aperture, but also by the subconoid form, swollen and not tapering at the base, by the whorls not being twisted, the last one, more convex, is well rounded in its lower part (*L. & B.*).

11. GRANOPUPA DUPOTETI (Terver). Pl. 47, figs. 7, 8.

Shell very small, swollen, conic, corneous, most minutely striate, umbilicate; aperture subrotund, toothless; 5 rounded whorls; suture deep; peristome simple, subreflected. Length 1½ to 2 lines, diam. 1 line (*Terver*).

Shell small, perforate and arcuately rimate, conic, thin, cinnamon-brown, glossy, very lightly irregularly striate. Spire conic, the apex obtuse. Whorls strongly convex, the last rounded below, very slightly and slowly ascending in front. Aperture shortly oval, slightly oblique, without teeth; peristome thin, whitish, the terminations approaching, the columellar margin dilated, other margins unexpanded, connected by a short, thin parietal callous. Length 4, diam. to edge of lip 2 mm.; 4½ whorls.

Algeria: Bougie; between the blockhouse of Kalifa and Fort Clausel; rocks above Si-Aya-Bosgri; near Fort Bonäck, etc. (Dupotet); around Bone (Letourneux); Cime de Bou-Mécid, near Constantine (Raymond, Brondel). Sidi-Yahia, Gorges of the Isser, Kabylia (Letourneux).

Vertigo dupoteti TERVER, Cat. Moll. terr. et fluv. nord de l'Afrique, 1839, p. 32, pl. 4, f. 11.—PFR., Monogr., iv, 664.—BOURGUIGNAT, Malac. de l'Algérie, ii, p. 96, pl. 6, f. 25-27.—LETOURNEUX, La Kabylie, p. 228.—? *Pupa dupontii* PAETEL, Catalog, p. 107.—*Pupa rupestris* ROSSMAESSLER, Iconogr., pts. ix and x, 1839, p. 25, 44, pl. 49, f. 637; not of Philippi.

M. Dupotet observed only two tentacles, those bearing the eyes. They are quite short; the animal is lighter or darker gray, sometimes nearly black.

Bourguignat notes that the examples from Bone and Bou-Mécid are ordinarily *plicatulate-striate*, while those from the environs of Bougie are more usually *minutely striatulate*. His figure (copied in pl. 47, fig. 7) agrees well with that of Terver, and shows the margins of the peristome converging less than in the specimen drawn in fig. 8. In younger individuals the margins approach less and the parietal callous is longer than in the old of the same lot.

Westerlund's phrase "Marg. distantibus, non conniventibus" is inexact for adult shells. Bourguignat described the structure better: "bords marginaux très-rapprochés, convergents et reunis par une faible callosité."

12. GRANOPUPA EUCYPHOGYRA (Let.). Pl. 47, fig. 6.

Shell openly perforate, long-conic, subpellucid, glossy, cor-

neous, obliquely and sharply striatulate; spire acuminate, long, the apex large, obtuse, smooth. Whorls 6, swollen, regularly increasing, separated by a deep suture, the last turgid-rounded, slightly ascending, equal to one-third the height. Aperture nearly vertical, slightly lunate, subrotund; peristome unexpanded, subacute, slightly thickened, the columellar margin expanded, margins strongly approaching. Length 4, diam. 2 mm. (*Let.*).

Algeria: under rocks of a dolmen of the defile of Mazla, in the region of the Oued-Zenati (Let.).

Pupa eucyphogyra Letourneux, Annales de Malacology, i, 1870, p. 311, pl. 6, f. 8-10.

This species has more whorls and a longer spire than *dupotteti*, with which it agrees in having a toothless aperture.

Pupa papieri Hagenmüller MS., from Cap de Garde à Bône, and *Pupa octavia* Hagenmüller MS. in coll. Fagot, are undescribed forms related to *eucyphogyra*, according to Caziot and Fagot, Ann. Soc. Linn. de Lyon, vol. 53, 1907, p. 197.

Sicilian Species.

13. Granopupa rupestris (Phil.). Pl. 49, figs. 1, 2, 3, 6.

Shell two lines long, a little over one wide, conic-turrited, the apex obtuse, ornamented with elevated striæ, reddish brown, pellucid. Whorls 5½ to 6, very convex, swollen, the last largest. Aperture obliquely ovate, more than half the length of the spire; lip simple, not reflected, the extremities approaching; umbilical fissure large and deep (*Phil.*).

The first whorl is large, projecting, and turned in at the tip. The last whorl ascends a little towards the lip. The surface has a golden gleam, and is sculptured with riblets which become a little more widely spaced on the last whorl. The outer lip is unexpanded, columellar lip dilated. There are no traces of apertural teeth.

Length 4, diam. 2.2 mm.; 5½ whorls.

Length 4.3, diam. 2.3 mm.; 5 whorls.

Sicily: Palermo, Sciacca (Phil.); Monte Pellegrino near Palermo; Termini, Monte S. Calogero (Benoit); island of Ustica; il Pirajno sulle Madonie (Calcara); also Siracusa,

Mazzara and island of Maretimo, the specimens larger and dark chestnut (Benoit).

Bulimus rupestris PHILIPPI, Enumeratio Molluscorum Siciliae, 1836, p. 41, pl. 8, f. 18.—*Pupa rupestris* Phil., ROSSM., Iconogr., ii, pt. x, p. 25, in part.—PHILIPPI, Enum., ii, p. 113.—KUESTER, Conch. Cab., p. 19, pl. 3, f. 1-3.—PFR., Monogr., ii, p. 310.—BENOIT, Illustr. sist., crit., iconogr. Testac. estramar. Sicil., pl. 5, f. 36; Nuovo Catal. Conch. terr. e fluv. Sicilia, 1881, p. 95.—*Pupa* (*Rupestrella*) *rupestris* Ph., MONTEROSATO, Il Nat. Siciliano, xiii, 1894, p. 170 (Monte Pellegrino).—*Pupa rupestris var. b*, A. BIVONA, Nuovi Moll. terr. e fluv. Palermo, 1839, p. 19, fig. 9.

Not *Pupa rupestris* Studer, var. *conica* Ben., DE GREGORIO, Il Nat. Siciliano, xiv, p. 204, error for *Helix rupestris conica* Benoit.

This species is much more strongly ribbed than the Algerian *dupoteti*, with which some authors confused it. It appears from the records to be widely spread in Sicily; but there are several varieties which require local study.

The typical form (pl. 49, fig. 6) is 4 mm. long or slightly larger, rather finely rib-striate, with about 5½ whorls.

G. rupestris coloba n. subsp. Pl. 49, fig. 4. A smaller form, length 3.1, diam. to edge of lip 1.8 mm., 5 whorls; more coarsely striate.

There is also a form with far less convex whorls (pl. 49, fig. 2), which may possibly be a different species.

14. GRANOPUPA HOMALA (West.).

Shell rimate-perforate, ovate-conic, reddish-brown, rather obsoletely, obtusely costulate; spire broadly conic. Whorls 5½, convex, separated by an impressed suture, regularly increasing, the last whorl a little larger than the penult, not swollen, rounded at the base, and ascending a little in front. Aperture ovate, toothless, the margins joined by a very thin callous; columellar margin lightly arched, the outer margin strongly curved above. Length 5, width 2¼ mm. (*West.*).

Sicily: Monte Galdo (M. de Monterosato).

Pupa (*Torquilla*) *homala* WESTERLUND, Nachrbl. d. m. Ges., 1892, p. 192.—*Modicella homala* WEST., Synopsis, p. 102.

Most nearly related to *rupestris* Phil., which however has a far more slender, narrower and strongly twisted spire, with deeper, gutter-like suture and very convex whorls (*West.*).

15. GRANOPUPA OCCULTA ('Parr.' Rm.). Pl. 49, figs. 5, 7, 8, 9.

Shell small, scarcely rimate, fusiform-turrited, light corneous-brown, thin, translucent, lusterless, rib-striate. Whorls 5-6, convex, the last noticeably larger than the penult, scarcely as large as the others together. Suture deep. Aperture ovate, somewhat higher than wide; throat with 3 fold-like teeth, one each on columella (the largest), on the palate, and on the parietal wall. Lip-margins approaching. Length 2¼, width 1 line (*Rossm.*).

Sicily: campagna di Palermo, rare (Benoit).

Pupa occulta Parr. in litt., ROSSMAESSLER, Iconogr., ii, pt. 10, 1839, p. 25, pl. 49, f. 638.—PHILIPPI, Enum. Moll. Sicil., ii, p. 114.—KUESTER, Conch. Cab., p. 18, pl. 2, f. 25, 26.—PFR., Monogr., ii, p. 349.—BENOIT, Nuovo Catal. Conch. terr. e fluv. Sicilia, 1881, p. 94; Ill. Sist., crit., icon., etc., pl. 5, f. 35 (copy from Rossm.).—?? *Pupa* (*Torquilla*) *occulta* Rossm., WESTERLUND, Nachrbl. d. m. Ges., 1892, p. 193; Synopsis, 1897, p. 103.

Rossmaessler's figures are copied in pl. 49, figs. 7, 8. The shell is much like *rupestris* in shape and sculpture, but differs by having teeth—parietal, columellar and lower palatal.

In the specimen figured on pl. 49, fig. 9, the palatal plica is obsolete, but there is a slight thickening in its place; length 4.7, diam. over all 2.4 mm.; 6 whorls.

Pl. 49, fig. 5, represents a smaller example, length 3.5, diam. 2 mm., 5¼ whorls, in which only a columellar lamella is developed, though the shell appears to be adult. It is transitional to *rupestris*.

Westerlund's new diagnosis (1892) appears to apply to some other form, not to typical *occulta*.

16. GRANOPUPA SCALARIS (Ben.). Pl. 48, figs. 1, 2, 5, 7, 8.

A small and elegant shell, rimate, fusiform, rather fragile, of a yellowish color; spire with the summit obtuse; whorls 6 in number, obliquely and equally ornamented with riblets, the

elevation of which, in combination with the depth of the suture, renders the whorls obtusely carinate. Aperture ovate-elongate, with a distinct tooth on the wide columella; peristome simple, somewhat reflected above the place of the umbilicus; margins approaching. Length 4, diam. 1½ mm. (*Benoit*).

Sicily: campagne di Palermo and in Madonie (Benoit).

Pupa scalaris BENOIT, Nuovo Catalogo Conch. terr. e fluv. Sicilia, 1881, p. 96; Illustr. Sist., Crit., Icon., pl. 5, f. 37.—*P. scalaris* (Parr.) Rssm., WESTERLUND, Fauna, iii, 1887, p. 105. —*Modicella scalaris* Ben., WESTERLUND, Synopsis, 1897, p. 103, with var. *albidocostata*.—*Pupa scalarina* Gundlach, SOWERBY, Conch. Icon., xx, 1875, pl. 17, f. 153; not of Gundlach! —? *P. occulta* v. *scalarisca* PAETEL, Catal. der Conchylien-Sammlung, 1873, p. 108 (name only).

This peculiar little snail is distinguished by the scalariform spire of extremely convex whorls separated by a deep, wide sutural excavation; also the coarse costation. It recalls *Pineria* or *Spiraxis mirabilis*.

The shell is typically light brownish, between honey-yellow and isabella color, with lighter or whitish ribs; but some lots are darker, cinnamon-brown, the pale ribs therefore more contrasted (fig. 2). This form has been named var. *albidocostata* West.: "shell strongly, distantly ribbed, ribs whitish; length 5½, diam. 2¼ mm."

Prof. Gwatkin placed this species among those having teeth of the *Chondrina megacheilos* type; yet as there are certainly several mistakes in his lists, I leave *scalaris* in the same group with *rhodia* until the difference is confirmed.

The post-embryonic whorls are *very strongly swollen in the middle, contracted towards the sutures*. The median ridge often becomes lower on the last half of the last whorl, where a spiral furrow runs below it. Sculpture of *well-spaced oblique ribs*. The aperture is oblique, outer lip thin and scarcely expanded, columellar margin dilated, as usual in the group. There is a short but rather strong entering tooth-like lamella on the columella, and a smaller one on the parietal wall; both are often so far immersed that they scarcely appear in a direct front view (pl. 48, fig. 5) and this was apparently the case in

the specimen figured by Benoit. The parietal lamella is developed only in fully adult shells, is sometimes very small, and in some apparently adult shells is wanting. The palatal region shows a more or less conspicuous ridge corresponding to the external furrow. Very often a small white fold stands upon this ridge, though not in all adult shells; and the type of Benoit was without it. Specimens of full size and in the same lot may therefore be found with one, two or three teeth.

Length 5.5, diam. 2 mm.; 6½ whorls.

Length 4.5, diam. 2.1 mm.; 5¾ whorls.

P. gibilfunnensis, which I have not seen, does not appear to differ from the more fully toothed examples of *scalaris*, yet it may be a distinguishable race. Sowerby's *Pupa scalarina*, which he got tangled up with a Cuban *Cerion*, is the tridentate form of *scalaris*. Westerlund's diagnosis of *occulta* (Nbl. d. m. Ges., 1892, 193) reads a good deal like *scalaris*.

Var. (?) *gibilfunnensis* (De Greg.).—"A small, elegant, very characteristic species. It is of an earthy color, ornamented with marked, laminar, oblique riblets. That which characterizes and distinguishes it from other related forms is: (1) the shape of the whorls, which are (especially the penult) extremely convex in the middle, constricted anteriorly and posteriorly, in such manner that they are carinate. (2) The arrangement of teeth in the aperture, of which there are two rather large on the columellar side, one rather slender on the outer lip. This last tooth is much less conspicuous, situated within, and sometimes transformed into a fold, or a slight protuberance; it corresponds to a concavity of the outer side of the whorl, which is continued spirally to the outer lip, in which it frequently produces a sinuosity.

"This species is related to *scalaris* Ben. (Ill. Sist., pl. 5, f. 37; Nuovo Cat., p. 96) and also *philippii* Cantr. (Ben., Ill. Sist., pl. 5, f. 38), but is quite distinct from both by the shape of the whorls and by the tooth of the outer lip" (*Pupa gibilfunnensis* De Gregorio, Il Naturalista Siciliano, xiv, Sept. 1895, p. 204).

Sicily: Monte Gibilfunni, near Palermo (De Gregorio).

17. GRANOPUPA REFUGA (West.).

Very similar to *Pupa rupestris* Phil., but the shell is more slender, more distantly and more strongly ribbed, the riblets

obtuse; last whorl not inflated; aperture oblong-oval; and especially distinct by the strong, white, transverse fold on the upper part of the columella (*West.*).

Sicily: Palermo (Westerlund).

Pupa (*Torquilla*) *refuga* WESTERLUND, Nachrbl. d. m. Ges., 1892, p. 192; *Modicella refuga* WEST., Synopsis, p. 102.

As this species has not been figured, and no dimensions are given, its identification is not without hazard. However, the description, as far as it goes, applies to a variable species which is rather common in the Palermo district, drawn in pl. 49, figs. 10 to 14.

The shell is cinnamon-brown to chestnut-brown, turrited-conic; whorls strongly convex, *the penult conspicuously inflated* (sometimes even obtusely subangular), last whorl less inflated, its latter half somewhat flattened or even sulcate below the periphery. Sculpture of coarse, somewhat irregularly spaced, oblique ribs. Aperture having: (1) a rather strong but short lamella high on the columella, fig. 11; (2) the same, with a smaller or minute parietal lamella, fig. 14; (3) columellar and parietal lamellæ and a palatal plica, figs. 12, 13.

These tooth-varieties occur in the same lots as received. The parietal lamella is often extremely small.

Length 5, diam. 2 mm.; 6 whorls (fig. 12).

Length 4.3 mm.; 5½ whorls (fig. 14).

This form is most closely related to *scalaris*, with which it may, indeed, prove to intergrade; but the median inflation of the whorls is less marked in *refuga*, not conspicuous except on the penult whorl. *G. occulta* has much more regular form and closer striation.

Pup.[*a*] *unicarinata* Potiez et Michaud, Galerie des Mollusques Mus. de Douai, i, 1838, p. 175, pl. 17, f. 11, 12, of Sicily, was evidently a shell of the *occulta* or *refuga* kind, scarcely to be identified without reference to the type. Westerlund has included it in his *Fauna* with an abstract of the original description, but it has never been identified with a real shell. Fortunately the name was previously used by Lamarck (see vol. xvi, p. 132), so the species may be dropped.

APPENDIX.

GASTROCOPTA PERVERSA (Sterki). Pl. 46, fig. 13.

Page 40. Several dextral specimens were found in the drift debris of the Salt River, Tempe, Arizona, by Ferriss, Daniels and Pilsbry in 1910. The normal form occurs in the same deposit. We do not know whether these represent a dextral colony or race, or are merely "accidental," but in considerable lots from other localities gone over, all are sinistral. These dextral shells may be known as *G. perversa*, form *sana* (pl. 46, fig. 13).

GASTROCOPTA PROCERA DUPLICATA Sterki (p. 65).

This name being preoccupied, becomes *G. p. sterkiana* Pils. (p. 127).

GASTROCOPTA WOLFII (Miller). Page 94.

GASTROCOPTA MUNITA (Reibisch). Page 96.

In Proc. Biological Soc. Washington, vol. 30, p. 10, Jan. 22, 1917, Dr. Dall writes:

"Paul Reibisch described a species of *Pupilla* under the name of *wolfi* which he supposed to be the same as the *P. wolfi* of Miller, originally from Guayaquil on the mainland. Dr. Pilsbry informs me that the Galapagos species is not the same as the continental *wolfi*, and therefore I propose for it the specific name REIBISCHI. Reibisch's *P. clausa* and *P. munita* seem sufficiently distinct."

The facts appear to be: Herr Reibisch did not describe *Pupilla wolfi*, but he *figured* a specimen of *Pupa wolfii* Miller, *from the Province of Guayaquil*, for comparison with his new *Pupa munita* from the Galapagos. There appears to be no reason for doubting, and I have never doubted, that *Pupa wolfii* Miller was correctly identified by Reibisch.

Dr. Dall's new name [*Pupilla*] *reibischi*, being based upon "the Galapagos species," becomes, I presume, a synonym of *Gastrocopta munita* (Reibisch); or, if it is held to be based upon Reibisch's pl. 2, fig. 11, it will be a synonym of *Gastrocopta wolfii* (Miller), of Guayaquil.

Pupa wolfii has been reported from the Galapagos only by Dr. Dall, and all of his specimens, which he courteously permitted me to examine, are *P. munita* of Reibisch. There is at present no evidence that *P. wolfii* exists on the Galapagos. Having carefully compared long series of *munita*, from several islands of the Galapagos group, with Guayaquil Province *wolfii*, I found them constantly distinct. See last paragraph on p. 96 of this volume.

Dr. Dall's note was doubtless written before he had seen the account in this volume, pp. 95, 96, published Dec. 18, 1916, where the status of the species involved is sufficiently exposed. I fear also that there may have been some ambiguity in my letter to him on the subject—in which case the error here corrected must have been due to my own vagueness. Certainly I intended to convey the conclusions stated on pp. 94-99, which had just then been written.

G. wolfii sometimes has a very low swelling behind the outer lip, though typically there is none.

Page 120. The following species is to be inserted after *G. pleimesi:*

65½. Gastrocopta haggenmacheri (Jick.).

Shell rimate, cylindric-ovate, white, glossy, diaphanous, under the lens obsoletely striated longitudinally, covered with dirt; spire somewhat tapering, the apex obtuse. Whorls 5, slightly convex, separated by a rather impressed suture, the last equal to one-third of the length, a little compressed at base, with a bifid sulcus. Aperture rounded, 6-plicate: a fold on the parietal wall divided by a deep sinus, the anterior part forming a minute denticle; 2 columellar folds, the lower one situated on the angle between columellar and basal margins; 3 palatal folds, the upper one punctiform, the middle and

lower joined together. Peristome a little expanded, the margins converging. Length 1¾, diam. maj. 1 mm. (*Jickeli*).

Abyssinia: Habab, on Nakfa, in the gorge of Asqaq.

Pupa haggenmacheri JICKELI, Fauna der Land- und Süsswasser-Mollusken Nord-Ost-Afrika's, in Nova Acta Acad. Caes. Leop.-Carol. Germ. Nat. Cur., vol. 37, 1875, p. 118.

It is readily distinguished from the preceding [*Pupa klunzingeri* and *Pupa pleimesi*] by the more compressed shape, and further differs from *P. klunzingeri* by the second columellar fold and the third palatal fold; from *P. pleimesi* by the absence of a second denticle on the parietal wall (*Jickeli*). The single specimen found was broken in measuring. It has not been figured.

GASTROCOPTA DAMARICA (Ancey). Page 125.

A specimen of the form described as *Pupa ridibunda* M. & P., from Cradock (Farquhar) is drawn in pl. 46, fig. 12. It differs from the specimens of *damarica* already figured by being decidedly more sharply striate, and by having the lower palatal fold somewhat larger, entering more deeply, or in some specimens more immersed as a whole. The peristome is *continuous*, as a thin, slightly raised ledge, across the parietal wall, while in typical *damarica* it is very short and adnate. Length 2.1 mm. These small differences will probably not prove constant enough for recognition of *ridibunda* as a subspecies, but this point can be determined only by the examination of long series.

GASTROCOPTA (?) INSULSA (Preston).

The figures of *Ennea insulsa* Preston, Proc. Zool. Soc. London, 1913, p. 205, pl. 33, figs. 13, 13*a*, from Gazi, British East Africa, are so similar to *Gastrocopta damarica* in shape, size and teeth that I suspect a mistake in the genus. As I have not seen the shell, and nothing is said of its texture, the question is left to those having access to specimens.

P. 179. TONKINIA MIRABILIS Mab. This species has been shown to belong to the *Streptaxidæ*, in which *Tonkinia* is a valid genus. See Kobelt and Von Moellendorff, Monograph of *Streptaxidæ* in Küster's Conchylien Cabinet.

P. 182. HYPSELOSTOMA INSULARUM Pils. The reference to figures should be: Pl. 32, figs. 1 to 5.

P. 184. *M. l. major* Mlldff. Reference to figure should be: Pl. 32, fig. 9.

P. 184. *H. l. imbricata* Mlldff. Reference to figures should be: Pl. 32, figs. 10, 11, 13.

P. 185. HYPSELOSTOMA QUADRASI Mlldff. Reference to figures should be: Pl. 32, fig. 6.

EXPLANATION OF PLATES.

Except when stated otherwise, the specimens figured are in the collection of the Academy of Natural Sciences, and were drawn by Miss Helen Winchester.

FIGURE PAGE

PLATE 1. Gastrocopta.

1. Gastrocopta armifera Say. Type specimen. 15
2-4. Gastrocopta armifera Say. Germantown, Philadelphia. 73876 15
5. Gastrocopta a. affinis St. Evansville, Wis. 98273 .. 18
7. Gastrocopta a. similis St. Rose Hill, Ont. 98272 ... 17
7-9. Gastrocopta a. clappi St. Knoxville, Tenn. 98279.. 20
10. Gastrocopta a. ruidosensis Ckll. Ruidoso, N. M. 73944. 19
11. Gastrocopta a. ruidosensis Ckll. Gallinas Cn., N. M. 84465 19

PLATE 2. Gastrocopta.

1, 3. Gastrocopta armifera abbreviata St. Eastport, Iowa. 98270 18
2. Gastrocopta a. abbreviata St. Shawnee Co., Ks. 11639. 18
4-6. Gastrocopta holzingeri St. Joliet, Ill. 47545 25
7. Gastrocopta h. agna P. & V. Trinidad, Colo. 93052.. 26
8. Gastrocopta contracta peninsularis Pils. Crystal R., Citrus Co., Fla. 24
9, 12. Gastrocopta contracta Say. Troy, N. Y. 22
10. Gastrocopta contracta Say. Fairfax Co., Va. 101573. 22
11. Gastrocopta contracta Say. Washington, D. C. 11607. 22

PLATE 3. Gastrocopta.

1, 4. G. contracta climeana Van. Type. 97605 24
2, 3. G. pentodon Say. Lebanon Springs, N. Y. 68885.. 28
5. G. pentodon Say. Ventnor, Atlantic City, N. J. 104640. 28
6. G. pentodon Say. Ocean City, N. J. 72709..... 28
7, 8. G. pentodon Say. Troy, N. Y. 58251 28
9. G. p. tappaniana Ad. Philadelphia, Pa. 58224 33

FIGURE PAGE

10, 12. G. pilsbryana St. Oak Creek, Arizona. 79413... 34
11. G. pilsbryana St. S. Catalina Mts., Ariz. 109656... 34

PLATES 4, 5. Gastrocopta pentodon and varieties.

Explanation of figures 1-41 on page 32; figs. 42-53, on page 34.

PLATE 6. Gastrocopta.

1, 2, 8. G. cochisensis P. & F. Tanner canyon. Huachuca Mts. 97442 44
3. G. cochisensis P. & F. 109679 44
4. G. cochisensis P. & F. Santa Rita Mts. 78693 44
5. G. ashmuni St. Dragoon Mts., Ariz. 112381 41
6, 7. G. ashmuni St. Dragoon Mts., Ariz. 112383 41
8. G. cochisensis P. & F. Huachuca Mts., Ariz. 97442.. 44
9, 10. G. perversa St. Benson, Arizona. 112063 40
11. G. perversa St. Dragoon Mts., Ariz. 112390 40

PLATE 7. Gastrocopta.

1-5. G. prototypus Pils. Cotypes. 82823 47
6, 7. G. basidentata Pils. Type. 190017 U. S. N. M..... 48
8-11. G. oligobasodon P. & F. Ash canyon, Chiricahua Mts. 97444 46

PLATE 8. Gastrocopta.

1-4. G. bilamellata St. & Clapp. E. of Quartzsite, Arizona. 98268 51
5-7, 9. G. dalliana St. Nogales, Arizona. 78689..... 49
8. G. dalliana St. Dragoon Mts., Arizona. 112395 49
10, 11. G. dalliana media Pils. Montezuma's Well. 82918. 50

PLATE 9. Chaenaxis.

1, 2. Chaenaxis tuba P. & F. Benson, Ariz. 112062 2
3. Chaenaxis tuba P. & F. Tucson, Ariz. 112124 2
4, 5. Chaenaxis t. brevicostata Pils. Tempe, Arizona.... 4
6. Chaenaxis intuscostata Clapp. Tucson, Arizona 3
7-9. Chaenaxis intuscostata Clapp. Cotypes. 99599 3

PLATE 10. Gastrocopta.

1, 2. G. corticaria Say. Upper Red Hook, N. Y. 52
3, 4. G. corticaria Say. Philadelphia, Pa. 64524 52
5. G. carnegiei St. Type. Coll. Sterki 35

FIGURE PAGE
6. G. marginalba Pfr. S. Vicente Banos, Cuba 60
7, 10. G. quadridens Pils. Capitan Mts., N. M. 74567 .. 57
8, 9. G. marginalba Pfr. Matanzas, Cuba..... 60

PLATE 11. Gastrocopta.

1. G. rupicola Say. Lossman's Key, Fla. 105353 58
2. G. rupicola Say. South Carolina. 3927 58
3, 5, 6. G. rupicola Say. Seville I., L. George, Fla. 69545. 58
4, 7, 9. G. r. duplex Pils. Bermuda. 105797..... 60
8. G. marginalba Pfr. After Küster 60
10, 11. G. marginalba Pfr. Bermuda. 91154 60
12, 13. G. marginalba Pfr. Matanzas, Cuba 60

PLATE 12. Gastrocopta.

1-5. G. procera Gld. Washington, D. C. 28815 62
6. G. p. riparia Pils. Galveston, Texas. 78684 65
7, 8. G. p. sterkiana Pils. (*duplicata* St.). Glenrose, Texas. 105745 357
9, 10. G. riograndensis St. Type. Hidalgo, Tex. 601337. 69

PLATE 13. Gastrocopta.

1, 2. G. mcclungi Hanna. Clay Co., S. D. 110762 66
3. G. mcclungi. Chamberlain, Brule Co., S. D. 110997.. 66
4, 5. G. mcclungi. Rogers, Ark. 90440 66
6. G. cristata P. & V. Tempe, Ariz. 112031..... 68
7. G. procera sterkiana Pils. Glenrose, Texas. 105745.. 357
8-12. G. cristata P. & V. Camp Verde, Arizona. 78694.. 68

PLATE 14. Gastrocopta.

1. G. rupicola matacumbensis Pils. Type. 105511 60
2, 3. G. rupicola matacumbensis Pils. Topotypes. 105509. 60
4. G. servilis Gld. St. Thomas. 60550 70
5, 6. G. servilis Gld., Cuba. 60548 70
7. G. servilis Gld. Somerset, Bermuda. 100483 70
8. G. s. riisei Pfr. Water Island, near St. Thomas. 3811. 74
9. G. s. riisei Pfr. Water Island, near St. Thomas. 22944. 74
10. G. desiderata Weinl. After Weinland 73

PLATE 15. Gastrocopta.

1-3, 5. G. pellucida Pfr. Cuba. 10036 75
4, 9. G. p. delicata Pils. Type and paratype 78
6. G. ovumformicae Weinl. After Weinland 82

FIGURE PAGE

8. G. longurio Cr. After Crosse 82
7, 10. G. pellucida biminiensis Pils. Rosario, Cuba 78
11-13. G. pellucida biminiensis Pils. South Bimini Cay. 114028 78

PLATE 16. Gastrocopta.

1-27. G. pellucida hordeacella Pils. Localities on p. 80.. 78
Figures drawn to one scale, by E. G. Vanatta.

PLATE 17. Gastrocopta.

1, 2. G. pellucida hordeacella Pils. Drift of Pecos River, Texas. 90494 78
3. G. pellucida hordeacella Pils. New Braunfels, Texas. 60460 78
4. G. pellucida hordeacella Pils. Guajadami, L. Cal. 190397 U. S. N. M. 78, 80
5, 6. G. polyptyx Pils. St. Thomas. 60547 89
7. G. polyptyx Pils. Jamaica. 10035..... 89
8. G. pellucida parvidens St. Jerome, Arizona. 78717.. 80
9. G. oblonga Pfr. After Küster 90
10. G. nodosaria Orb. After d'Orbigny 94
11, 12. G. barbadensis solitaria Smith. After E. A. Smith. 88
13. G. pazi Hidalgo. After Hidalgo 102
14. G. oblonga Pfr. Fortaleza. 171445 U. S. N. M. 90
15. G. oblonga Pfr. Para. 91128 90
16. G. iheringi Sut. Paratype. 22940 101

PLATE 18. Gastrocopta.

1, 3. G. barbadensis Pfr. Barbados. 85464 83
2. G. barbadensis Pfr. Barbados. 57202 83
4, 5. G. barbadensis Pfr. Guadalupe. 59903..... 83
6. G. b. crassilabris Pils. Somerset, Bermuda. 101752*a*. 85
7-9. G. b. crassilabris Pils. Mangrove Cay, Andros. 180645 U. S. N. M. 85
10, 12. G. barbadensis Pfr. Varadero Park, Cuba 83, 85
11. G. uvulifera Guppy. After E. A. Smith 87

PLATE 19. Gastrocopta.

1-3, 6, 8. G. munita Reib. Albemarle. 215785 U. S. N. M. 96
4, 5. G. pfeifferi Bttg. (= munita). After Boettger ...96, 98
7. G. munita Reib. After Reibisch 96
9. G. clausa Reib. After Reibisch 99
10. G. munita Reib. Iguana Cove. 215782 U. S. N. M. 96

FIGURE PAGE
11. G. munita Reib. Narborough. 108517 U. S. N. M... 96
12-14. G. clausa Reibisch. Abingdon. 108516 U. S. N. M. 99

PLATE 20. Gastrocopta.

1, 2. G. chichijimana Pils. Type. 80325 105
3, 6. G. c. ogasawarana Pils. Type. 83224 106
4, 5. G. boninensis Pils. Type 107
7, 9, 10. G. armigerella Reinh. Miyakejima. 85789 107
8. G. armigerella (*atoma* Hde.). Shanghai. 64107..... 109
11. G. armigerella Reinh. Kunchan. 80992 107

PLATE 21. Gastrocopta.

1. G. armigerella hachijoensis Pils. Hachijojima. 83395. 109
2-4. G. coreana Pils. Kojeto, Korea. 95775..... 109
5-7, 10. G. hirasei Pils. China. 94774 110
8, 9. G. monadicula Hde. After Heude..... 111
11. G. theeli West. After Westerlund 118
12. G. ejecta B. & D. After Bavay and Dautzenberg.... 111
13, 14. G. baudoni Mich. Pliocene, Hauterive. 4257 ... 114
15, 16. G. huttoniana Bens. Kashmir. 84272..... 137
17. G. huttoniana Bens. Conch. Indica 137

PLATE 22. Gastrocopta.

1, 2, 4. G. dupuyi Mich. Pliocene, Hauterive 113
3. G. klunzingeri Jick. Abyssinia 120
5, 6. G. pleimesi Jick. After Jickeli 119
7. G. hermosa Jouss. After Jousseaume 121
8, 10, 13. G. acarus Bens. Fogo, Azores. 97279 122
9. G. microbus Morel. After Dautzenberg 123
11, 12. G. flocculus Morel. After Morelet 124
13. G. acarus Bens. Fogo, Azores. 97279 122
14-16. G. damarica Anc. Pienaar's Poort. 106484 125

PLATE 23. Gastrocopta.

1, 4. G. seignaciana Cr. Nossi-Bé. 22926 128
5. G. tripunctum Morel. After Morelet 130
6. G. seignaciana Cr. After Crosse..... 128
7, 12. G. tripunctum Morel. Mayotte. 22927 130
8. G. microscopica Marts. Mauritius. 64102 131
9. G. lienardiana Crosse. Bourbon 132
10. G. lienardiana Crosse. After Crosse 132
11. G. l. eudeli Pils. Bourbon. 64091 133
12. G. tripunctum Morel. Mayotte. 22927 130

FIGURE PAGE
13-15. G. microscopica Marts. After von Martens..... 131
16, 17. G. mimula Bens. Ceylon. 22935 134

PLATE 24. Gastrocopta.

1, 2. G. lyonsiana Anc. Kualii, Oahu 141
3. G. lyonsiana Anc. Pearl Harbor. 108730 141
4. G. lyonsiana Anc. Kawaihapai. 109957 141
5, 6. G. lyonsiana kailuana Pils. Kailua, Oahu 143
7, 11. G. lyonsiana "var. cornea" Bisucay, Calamianes. 96009 144
8, 12, 13. G. moellendorffiana Pils. Philippines..... 145
9. G. microsoma Tap.-Can. After Canefri..... 152
10. G. recondita Tap.-Can. After Canefri 153
11. G. lyonsiana "var. cornea." Bisucay, Calamianes. 96009 144
12, 13. G. moellendorffiana Pils. 145
14. G. obstructa Gassies (= neocaledonica). After Gassies. 154
15. G. niobe Fulton. After Fulton 153

PLATE 25. Gastrocopta.

1-3. G. pediculus Sh. Marquesas Is. 83161 .....145, 147
4, 9. G. palmira Stol. After Stoliczka..... 139
5, 8. G. pediculus Shuttl. (artensis Montr.). New Caledonia. 22928 .....145, 148, 150
6, 7. G. pediculus nacca Gld. Manoa Valley, Oahu 149
10, 11. Nesopupa filosa Stol. After Stoliczka.
12. Gastrocopta pediculus ("samoensis"). Samoa. 22929. 145, 151
13. G. pediculus ovatula Mlldff. Loboc. 96011 149
14. G. artensis (= pediculus). After Montrouzier...145, 150
15. G. p. ovatula Mlldff. Sierra Bullones, Bohol. 96012. 149

PLATE 26. Gastrocopta.

1. G. pediculus Sh. (rossiteri Braz.). Point Piper. 115539. 158
2. G. p. queenslandica Pils. Calliungal. 115630 159
3, 5. G. strangei Pfr. Sydney, N. S. W. 22934 157
4, 6. G. strangei Pfr. Narrabri. 63262 157
7, 8. G. margaretae Cox. After Cox 160
9, 10. G. tatei Pils. Type. (The columellar lamella of fig. 10 is drawn incorrectly. See pl. 30, fig. 12). 165
11. G. avanica Bens. Ava. *Indian Museum* 138
12, 13. G. moretonensis Cox. After Cox 161
14. G. bathyodon Bens. Nerbudda Valley. *Indian Museum* 136

FIGURE PAGE

PLATE 27. Gastrocopta.

1-4. G. hedleyi Pils. Cotypes. 63279 166
5, 6. G. mussoni Pils. Type. 115541 167
7, 8, 10. G. m. macrodon Pils. Type. 63068 164
9. G. macleayi (= macdonnelli). 115542 162
11, 12. G. macdonnelli. 115538 162

PLATE 28. Gastrocopta, Gibbulina, Bothriopupa.

1. Gastrocopta wolfii Mill. Duran, near Guayaquil 94
2, 3. Gastrocopta wolfii Mill. Ecuador. 307631 U. S. N. M. 94
4. Gastrocopta wolfii Mill. After Miller 94
5, 6. Gibbulina infundibuliformis Orb. After d'Orbigny. 6
7. Bothriopupa conoidea Nc. Cariaquita. 105199 231
8, 11. Bothriopupa conoidea Nc. Demerara 231
9, 10. Bothriopupa breviconus Pils. Guatemala. 107534. 230
12-14. Bothriopupa geminidens Pils. Type and paratypes. 105200 228

PLATE 29. Bothriopupa, Gastrocopta.

1. Bothriopupa leucodon Morel. After Fischer & Crosse. 232
2. Bothriopupa variolosa Gld. Big Pine Key, Fla. 104026. 230
3. Bothriopupa variolosa Gld. Little Marco, Fla. 92889. 230
4. Bothriopupa leucodon Morel. Specimen 232
5, 7. Bothriopupa tenuidens Ad. Mandeville, Jamaica. 101497 229
6. Bothriopupa tenuidens Ad. Jamaica 229
8. Gastrocopta bathyodon Bens. After Conch. Indica... 136
9. Gastrocopta avanica Bens. After Conch. Indica 138
10. Gastrocopta barrackporensis Gude. After Conch. Indica 135
11-13. Bothriopupa tenuidens Ad. Cariaquita. 105199.. 229

PLATE 30. Gastrocopta.

1. G. larapinta deserti Pils. Forrest River. 115540 170
2, 3. G. larapinta deserti Pils. Central Australia. 72481. 170
4. G. mooreana Smith. After E. A. Smith 160
5-7. G. larapinta Tate. Paratypes from Prof. Tate 168
8. G. mussoni (?). Calliungal. 115631..... 168
9, 11. G. larapinta Tate. Central Australia. 72478 168
10. G. larapinta Tate. After Tate..... 168
12. G. tatei Pils. Type 165

FIGURE PAGE

PLATE 31. Hypselostoma.

1-5. Hypselostoma tubiferum Bens. 22656 and 1215.... 178
6, 7. Tonkinia mirabilis Rochebr. After Rochebrune.... 359
8-10. Hypselostoma roebeleni Mlldff 186
11-13. H. annamiticum altius Pils. Annam 181
14, 15. H. laidlawi Cllge. After Collinge 181

PLATE 32. Hypselostoma.

1-5. H. insularum Pils. Type. 95252 182
6. H. quadrasi Mlldff. 96539 185
7, 8. H. luzonicum Mlldff. After Boettger 183
9. H. luzonicum major Mlldff. After Boettger 184
10. H. luzonicum imbricata Mlldff. After Boettger..... 184
11. H. luzonicum imbricata Mlldff. 96542 183
12. H. edentulum Mlldff. 187
13. H. luzonicum imbricata Mlldff. 96541 184

PLATE 33. Anauchen, Boysidia.

1. Anauchen gereti B. & D. 189
2, 3. Anauchen gereti B. & D. After Bavay and Dautzenberg 189
4. Anauchen messageri B. & D. 189
5, 6. Anauchen angulinus Gredler. After Gredler 191
7. Anauchen messageri B. & D. After Bav. and Dautz... 189
8, 9. Boysidia hunana Gredler. After Gredler 194
10. Boysidia hunana conspicua Mlldff. 195
11. Boysidia salwiniana Theob. After Hanley & Theobald. 206
12-14. Boysidia hunana conspicua Mlldff. 195
15, 16. Boysidia strophostoma Mlldff. 197
17. Boysidia hangchowensis Pils. Type 196

PLATE 34. Boysidia.

1, 2, 4. B. plicidens Bens. Landour. 3933 198
3. B. plicidens Bens. Hangchow. 94775 198
5, 6. B. dayana Stol. After Stoliczka 205
7,8. B. boettgeri Mlldff. 69799 208
9, 10. B. plicidens Bens. Yoro, Mino. 84272 198

PLATE 35. Boysidia.

1, 2. B. robusta B. & D. 105062..... 201
3-6. B. lamothei B. & D. 105081 202
7, 8. B. paivei B. & D. 105095 203

FIGURE PAGE
9. B. landurensis Pils. Type. 16721 204
10, 11. B. kelantanensis Sykes. 98191 208
12. B. kelantanensis Sykes. After Sykes 208

PLATE 36. Gyliauchen.

1-4. G. hungerfordiana Mlldff. Gunong Pondok. 62516. 212
5, 8. G. transitans Mlldff. Siam 214
6, 7. G. transitans Mlldff. After Moellendorff 214
9, 10. G. crossei Morlet. After Morlet 215
11-13. G. crossei Morlet. 66063 215

PLATE 37. Gyliauchen.

1-3. G. fruhstorferi Mlldff. 69883 217
4-6. G. everetti Smith. 78403 218
7-9. G. dohertyi Fulton 219
10. G. everetti Smith. After E. A. Smith 218
11. G. bensonianus Blanf. 62170..... 211
12. G. bensonianus Blanf. Conch. Indica 211

PLATE 38. Aulacospira, Systenostoma.

1. Aulacospira mucronata Mlldff. 96547 222
2. Aulacospira porrecta Mlldff. 78406 222
3-5. Systenostoma pauperrima B. & D. After Bav. et Dautz. 225
6, 7. Aulacospira hololoma Mlldff. 78414 222
8, 9. Aulacospira scalatella Mlldff. 67983 223
10-12. Systenostoma pulverea B. & D. After Bav. et Dautz. 225
13. Aulacospira rhombostoma Mlldff. 98247 223
14, 17. Aulacospira azpeitiae. Hidalgo. 95550, 81595 .. 224
15, 16. Systenostoma defixa B. & D. After Bav. et Dautz. 226

PLATE 39. Fauxulus.

1-3. F. capensis Küster. Buffelsfontein. 106494 236
4. F. capensis Küster. Port Elizabeth. 65780 236
5. F. capensis ovularis Kurr. After Küster 238
6. F. capensis Kurr. After Küster..... 236
7. F. capensis ovularis Kurr. Large form. 22904 238
8. F. capensis (P. pottebergensis Kr.). After Küster... 240
9. F. capensis var. (P. fonticola Dh.). After Deshayes.. 239
10, 11. F. pamphorodon Bens. Simonstown. 64096..... 240
12. F. pamphorodon Bens. Simonstown. 106489 240

FIGURE PAGE

PLATE 40. Fauxulus.

1, 2. F. glanvilleanus novenarius Pils. Grahamstown.... 250
3. F. pereximius M. & P. After Melvill & Ponsonby 247
4, 5. F. mcbeanianus M. & P. Topotype 247
6. F. glanvilleanus darglensis Bnp. After Burnup 250
7, 9, 10. F. ponsonbyanus Morel. Grahamstown. 114967. 253
8. F. glanvilleanus tomlini Bnp. Somerset East 252

PLATE 41. Fauxulus, Gastrocopta, Odontocyclas.

1, 2. Fauxulus crawfordianus M. & P. After Burnup... 242
3. Gastrocopta duplicata Preston. After Preston 127
4-6. Fauxulus layardi Bens. Cape Point. 106495 243
7. F. l. stoaphora 'Bs.' Bnp. 64100 245
8. F. l. stoaphora 'Bs.' Bnp. After Burnup 245
9, 10, 11. Odontocyclas kokeilii Rm. 22700 256
12, 13. Odontocyclas rossmaessleri Schm. 114972, 22860. 257

PLATE 42. Abida.

1-4. Abida frumentum Drap. 3884 297
5. A. f. hungarica Kim. Nandor. 66048 302
6. A. frumentum turgida Parr., Küster. After Küster.. 300
7. A. frumentum pachygastra Zgl. 101618 302
8, 9. A. illyrica Rm. 114982 303
10, 11. A. frumentum pachygastra Zgl. After Rossmaessler 302
12, 15. A. apennina (Charp.) K. After Küster 305
13, 14. A. apennina (Charp.) K. 22820 305
16. A. apenrina (Charp.). Tuscany. 114981 305

PLATE 43. Abida.

1, 2. A. braunii Rossm. 66916 273
3. A. braunii Rossm. 22823 273
4-6. A. braunii Rossm. After Rossmaessler 273
7-9. A. partioti Moquin-Tandon. 67750 276
10. A. dupuyi West. After Westerlund 277
11. A. ringens bigerrensis Moq. After Moquin-Tandon.. 280
12-15. A. ringens Mich. 3896 278

PLATE 44. Abida.

1-3. A. polyodon Drap. 22843, 3882 270
4-8. A. polyodon ringicula Mich. Barcelona. 106561 ... 272
5. A. affinis Rossm. After Rossmaessler 282
6. A. affinis Rossm. 114977..... 282

FIGURE PAGE
7, 10. A. vergniesiana Ch., Küster. 22842 286
9. A. pyrenæaria Mich. After Dupuy 287
11. A. vergniesiana provida West. 3390 287
12. A. vergniesiana Ch., Küster. After Küster 286
13. A. petrophila Fagot. After Küster..... 291
14, 15. A. andorrensis Bgt. After Bourguignat 293

PLATE 45. Abida.

1, 2. A. illyrica cylindracea Rm. After Rossmaessler.... 305
3. A. illyrica minor Rossm. After Rossmaessler 304
4. A. illyrica elongata Rossm. After Rossmaessler 304
5-7. A. mortilleti Stab. (= stabilei Mts.). After Stabile. 318
8, 9. A. micheli Terver. After Dupuy 315
10. A. anceyi Fagot. 114978..... 317
11, 12. A. variabilis Drap. 22849 321
13. A. v. sabaudina Bgt. After Bourguignat..... 325
14. A. v. obliqua Nevill. After Nevill 325
15. A. v. sabaudina Bgt. Lausanne. 22855 325
16. A. v. polita Risso. After Risso 326
17. A. fusiformis var. minor K. (= A. atracta puella). After Küster 328
18, 19. A. fusiformis K. (= A. atracta). After Küster.. 327

PLATE 46.

1, 2. Sandahlia cylindrica Mich. 79952..... 259
3. Sandahlia cylindrica Mich. 3904 259
4. Granopupa granum saulcyi Bgt. After Bourguignat.. 338
5, 7. Sandahlia cylindrica curtata Pils. 22731..... 261
6. Abida illyrica gastrodes Pils. 22859 305
8. Abida frumentum curta P. & M. After Potiez & Michaud 299
9. Abida variabilis incerta Hartm. After Hartmann.... 323
10. Abida lapidaria Hutton. Conch. Iconica 330
11. Abida secale boileausiana Charp. After Küster 312
12. Gastrocopta ridibunda M. & P. (= damarica Anc.).. 359
13. Gastrocopta perversa sana Pils. Type 357

PLATE 47.

1. Granopupa michaudi Terver. 22804 345
2. Granopupa michaudi isseriana Pils. 75906 346
3. Granopupa granum Drap. 22699 335
4. Granopupa brondeli Bgt. 63612 346
5. Granopupa brondeli Bgt. After Bourguignat 346

FIGURE PAGE
6. Granopupa eucyphogyra Let. Ann. de Malac. 350
7. Granopupa dupoteti Terver. After Bourguignat..... 349
8. Granopupa dupoteti Terver. 3824 349
9. Chondrina guiraoensis Rm. 22790 .....Vol. XXV
10. Granopupa kabyliana Let. 75905 347
11, 14. Abida secale Drap. 22830 306
12. Granopupa granum Drap. Tuscany. 22697 335
13, 15. Abida secale Drap. 22835 306
16. Abida secale hordeum Studer. After Hartmann 308

PLATE 48. Granopupa.

1, 2. Granopupa scalaris Benoit. 22801, 22799 353
3. Granopupa nitida (Fér.) Küster. After Küster 343
4. Chondrina spelta obscura Mühlf., Küster. After Küster .....Vol. XXV
5, 7, 8. Granopupa scalaris Benoit. 22800 353
6. Chondrina spelta minor Rm. After Rossmaessler. Vol. XXV
7, 8. Granopupa scalaris Benoit. 22800 353
9. Chondrina spelta Beck. 22794 .....Vol. XXV
10. Chondrina spelta obscura Mühlf., Küster.....Vol. XXV
11. Chondrina spelta ventilatoris Parr. After Küster. Vol. XXV
12-14. Granopupa philippii Cantrine. 5194, 101625, 22802. 341
15. Granopupa rhodia Roth. 5195 344

PLATE 49. Granopupa.

1, 2. Granopupa rupestris Phil. 3901 351
3. Granopupa rupestris Phil. 22796 351
4. Granopupa rupestris coloba Pils. 352
5. Granopupa occulta Parr., Rossm. 353
6. Granopupa rupestris Phil. 22798 351
7, 8. Granopupa occulta Parr., Rossm. After Rossmaessler. 353
9. Granopupa occulta Parr., Rossm. 353
10-14. Granopupa refuga West. 355

DATES OF ISSUE OF THE PARTS OF VOL. XXIV.

PART 93, pages 1-112, plates 1-13, Dec. 18, 1916.
94, pages 113-176, plates 14-29, July 18, 1917.
95, pages 177-256, plates 30-38, Nov. 9, 1917.
96, pages 257-380, plates 39-49, March, 1918.

INDEX.

Note. — Names of genera and other groups are printed in SMALL CAPITALS; of synonyms in *italics*.

A

abbreviata St. 18
ABIDA Leach 262
abrupta West. 313
acarus Bs. 122
acavus Schauf. 122
acuta Kutsch. 344
adjuncta Ziegl. 303, 304
aemula Parr. 338
affinis Rossm. 282
affinis Sterki 18
agna P. & V. 26
albidocostata W. 354
ALBINULA Sterki..11, 13, 114
altius Pils. 181
ameliae Bgt. Loc. 272
ANAUCHEN Pils. 188
anceyi Fag. 317
andorrensis Bgt. 293
angularis West.....322, 325
angulinus Gredl. 191
ANISOLOMA Anc. 247
annaaensis Bk. 103
annamiticum Mlldff. ... 180
annobonensis Gir. 124
antiqua Schub. 270
apennina Charp. 305
appeliusi West. 329
arabica Dohrn. 330
arctespira Bgt. 324
armigera P. & M. 16
armigerella Reinh. 107
artense Mlldff. 142
artensis Montr. 147, 150
ashmuni St. 41
atoma Hde. 108, 109
atracta Pils. 327
attenuata Fag. 295
attrita Moq. 271, 272
AULACOSPIRA Mlldff. ... 220
aulusensis Fag. 290
auriformis Gupp. 88
avanica Bs. 138
azpeitiae Hid. 224

B

baillensi Dup. 280
baillensis West. 281
barbadensis Pfr. 83
barrackporensis Gude .. 135
barrattei L. & B. 349
barreri Bgt. 116
basidentata Pils. 48
bathyodon Bs. 136
baudoni Mich. 117
BENSONELLA Pils. 198
bensonianus Blf. 211
bermudensis Prime 72
Bifidaria Sterki 6
bigerrensis Moq. 280
bigoriensis Mich. 280
bilamellata S. & C. 51
biminiensis Pils. 78
bipalatalis W. 283, 284
blanci Poll. 319
boettgeri Mlldff. 208

bofilli Fag. 292
boileausiana Ch. 312
boninensis Pils. 107
Bothriopupa Pils. 226
boubeensis Fag. 289
bourgetica Bgt. 310
boysianum Bs., Nev. 137
Boysidia Ancey.....192, 194
braunii Rossm. 273
breviconus Pils. 230
brevicostata Pils. 4
brevituba Mlldff. 217
brondeli Bgt. 346
bugeysiaca Loc. 300
bulimæformis Woll. 337
bulimiformis Love 337

C

cadica Fag. 314
callosa Zgl., Rm. 298, 304
capensis Küst. 236
capillacea D. & S. 144
caprearum Phil. 342
carinata Gld. 63
carnegiei St. 35
cartennensis Let. 347
Carychium 131, 137
castanea Gredl. 303
catalonica Bof. 294
Cerion Bolt. 267
Cerium Link 268
Chænaxis P. & F. 1
charlotia Risso 322
chichijimana Pils. 105
Chondrina Reich. 234
Chondrus Cuv. 262, 268
cincinnatiensis Jdg. ...28, 29
clappi Sterki 20
clausa Reib. 99
clausilioides Boub. 288
clessini Doer. 93
climeana Van. 24
cochisensis P. & F. 44
Cochlodonta Fér. 268
coloba Pils. 352
columnella Loc. 315
conica Ben. 352
conispira West. 275
conoidea Nc., Pfr. 231
conspicua Mlldff. 195
contracta Say 22
coreana Pils. 109
cornea Mlldff. 142, 144
corrugata Loc. 261
corticaria Say 52
costata Fag. 314
crassilabris Pils. 85
crassilabrum Bgt. 275
crawfordianus M. & P... 242
crimoda Bgt., Loc. 299
cristata P. & V..... 68
cristella West. 277
crossei Morl. 215
curta Ant. 103
curta Issel 301
curta Küst. 300
curta Moq. 260, 261
curta Moq. 288
curta Pot. & Mich. 299
curta Sterki 34
curtata Pils. 261
curvidens Gld. 28
cycloides Moq. 274, 275
cylindracea Ziegl. 305
cylindrella Moq. 283
cylindrella Loc. 309
cylindrica Mich. 259
cylindricus Hartm. 307
cylindriformis Loc. 260
cylindroides Moq. 308

D

dalliana St. 49
damarica Anc.....125, 359
darglensis Bp. 250
dayana Stol. 205
decemplicata Bgt. 309
defixa B. & D. 226
delicata Pils. 78
delphinensis Loc. 324

deltostoma Charp. 22
deserti Pils. 170
desiderata Weinl. 73
dicrodonta Pils. 100
didymodonta Br. 116
didymodus Sdb. 116
diluta West. 338
disjuncta Moq. 279
dohertyi Fult. 219
dorsalis Mlldff. 196
dorsata Ancey 195
dufourii Fér. 259
duodecimcostata Loc. ... 310
duplex Pils. 60
duplicata St. 65, 127, 357
dupontii Paet. 350
dupoteti Terv. 349
dupuyi West. 277

E

ebrodunensis Bgt. 324
echthrodes West. 261
edentula Taylor 310
edentulum Mlldff. 187
ejecta Bav. & Dautz..... 111
elongata Moq. 279, 283
elongata Saulcy 308
elongata Ziegl. 304
elongatissima Bof. 285
elongatissima Dup. 260
endochila Germ. 283
endodonta Mlldff. 217
Eubifidaria St. 53
eucrina Bgt. 116
eucyphogyra Let. 350
eudeli Pils. 133
eudolicha Bgt. 283
euryomphalum Mlldff. .. 141
everetti Smith 218
exiguua Mouss. 342
exilis Moq. 273
eximia West. 328
extrema Hde., Mlldff. ... 108

F

fagorum Fag. 313
fagotiana Loc. 280
farcimen Sdb. 116
Faula Ads. 234
FAUXULUS Schauf. 234
ferdinandi And. 117
filosa Stol. 140
fischeri Dh. 117
fissidens Sdb. 117
flocculus Morel. 124
floridana Dall. 29, 30
fonticola Dh. 239
fordiana St. 26
fossanensis Sacco. 115
freseriana Bof. 284
fruhstorferi Mlldff. 217
frumentacea Loc. 298
frumentum Drap. 297
fryanus Bens. 246
fusiformis Küst. 328
fustis Bttg. 270

G

garumnica Fag. 281
GASTROCOPTA Woll. 6, 53
gastrodes Pils. 305
geminidens Pils. 228
gereti B. & D. 189
gibbosa Say 63
GIBBULINA Beck 5
gibilfunnensis de Greg... 355
gigantea Schr. 303
glanvilleana M. & P..... 249
glanvillianus Anc. 249
gracilidens Sdb. 116
gracilior Kregl. 308
gracilis Sterki 29, 31
Granaria Held. 262
graniformis Loc. 336
GRANOPUPA Bttg. 332
granum Drap. 335
Gredleriella Mlldff. 194

gourdoniana Fag. 313
Gyliauchen Pils. 210

H

hachijoensis Pils. 109
haggenmacheri Jick. ... 358
hangchowensis Pils. 196
hedleyi Pils. 166, 167
Helix infundibuliformis Orb. 6
Helix miliola Orb. 92
Helix moricandi Fér. ... 257
Helix nodosaria Orb. ... 94
hetaera West. 294
heterodus Bttg. 116
hirasei Pils. 110
hololoma Mlldff. 222
holzingeri St. 25
homala West. 352
hordacea Gabb. 69
hordeacea Binn. 69
hordeacella Pils. 78
hordeum Stud. 308
humilis Beck. 342
hunana Gredl. 194
hunanensis Mlldff. 194
hungarica Kim. 301
hungerfordianus Mlldff.. 212
hupeana Gredl. 206
huttoniana Bs. 137
hyalina Zel. 147, 152
Hydrocena milium Bs. 199, 200
Hypselostoma Bens. 175

I

iheringi Sut. 101
illyrica Rossm. 303
imbricata Mlldff.....184, 360
Immersidens P. & V. 11, 38, 100
incertus Hartm. 323
indica Pfr. 136
indigena Anc. 86
Infundibularia Pfr. 5
infundibuliformis Orb... 6
insularum Pils. 182, 360
insulsa Prest. 359
interpres St. 17
intrans West. 300
intrusa Slav. 269
intuscostata Clapp 3
ischurostoma Bgt. 323
isseriana Pils. 346
isserica Anc. 346
isseli Caz. 320

J

jamaicensis Ad. 75, 81
Jaminia Leach.....262, 268
javana Mlldff. 209
juniperi Mont. 307

K

kabyliana Let. 347
kailuana Pils. 143
kanalensis Caziot 305
kelantanensis Sykes 208
klunzingeri Jick. 120
kockeilii Poll. 256
kokeilii Rm. 256
kraliki Let. 311
krueperi West. 329
krüperi West. 330

L

labiosa Moq. 274
labiosa Moq. 323
laidlawi Cllge. 181
lamothei B. & D. 202
landurensis Pils. 204
lapidaria Hutt. 330
larapinta Tate 168
larteti Dup. 115
lasallei Bgt. 311
layardi Bens. 243
leptospira West. 295
Leucochilus Bttg. 6, 8
leucodon Morel. 232

lienardiana Cr. 132
lilietensis Bof. 293
limonensis West. 320
longa Moq. 260
longidens Cl. 117
longurio Crse. 82
longurio Moq. 283
luchuana Pils. 108
ludovici Bgt. 116
luzonicum Mlldff. 182
lyonsiana Anc. 141

M

macdonnelli Braz. 162
macleayi Braz. 163, 164
macrodon Pils. 164
magdalenae Bgt. 315, 316
magna Stab. 303, 304
major Bgt. 275
major Bof. 284
major Kregl. 304
major Mlldff. 184, 360
major Moq. 323
major West. 342
margaretae Cox 160
marginalba Pfr. 60
matacumbensis Pils. 60
mcbeanianus M. & P. 247
mcclungi H. & J. 66
mea Bgt., Loc. 299
media Pils. 50
meledana St. 344
meridionalis Ad. 338
meridionalis Mlldff. 111
meridionalis Strob. 303
messageri B. & D. 189
michaudi Terv. 345
michelii Terv. 315
microdonta Doer. 92
Micropetasus Mlldff. 220
microsoma T.-C. 152
migma West. 295
miliola Orb. 92
milium (Hydrocena) Bens. 199, 200
minima Kregl. 301
minor Bens. 245
minor Bgt. 336, 340
minor Küst. 328
minor Mich. 308
minor Moq. 323
minor Rossm. 272
minuta Say, Pfr. 63, 64
minuta St. 35
miocaena Brn. 269
mirabilis (Tonkinia) Mab. 359
moellendorffi Bttg. 209
monadicula Hde. 111
monas Hde. 108
montanella Ckll. 29, 31
montserratica Fag. 272
montsiccana Bof. 293
mooreana Sm. 160
moretonensis Cox 161
moricandi Fér. 257
mortilleti Stab. 318
mucronata Mlldff. 222
multidens Moq. 274, 275
multidentata Oliv. 326
munita Reib. 96, 357
mussoni Pils. 167
mutabilis Fér. 322
myrmecoon Crse. 82

N

nacca Gld. 147, 149
nana Mühlf. 342
nansoutyana Fag. 290
nansoutyi Fag. 289
nebraskana Binn. 22
necra Bgt. 116
neocaledonica Pils. 154
nodosaria Orb. 94
noerdlingensis Kl. 270
nouleti Mich. 116
nitens Pse. 146, 151
nitida Ant., Sowb. 343
nitida Fér. 343
niobe Fult. 153
nova Bgt., Loc. 299

novemplicata Bgt. 308
novemplicata Moq. 288
novenarius Pils. 250

O

obliqua Nevill 325
oblonga Pfr. 90
oblongata Rm. 302
obstructa Br. 117
obstructa Gass. 154
occidentalis Fag. 291
occulta Parr. 353
octavia Hagenm. 351
ODONTOCYCLAS Schluet. . 254
ogasawarana Pils. 106
olearum Bgt. 315, 316
oligobasodon P. & F..... 46
oparea Loc. 296
oryza Edw. 269
oryzana Loc. 310
ovampoensis M. & P..... 125
ovatula Mlldff. 149
ovularis Kurr. 238
ovularis Moq. 323
oyonnaxia Loc. 310

P

pachygaster Moq. 323
pachygastra Frass 270
pachygastra Ziegl. 302
pachygastris Küst. 302
pamphorodon Bens. 240
papieri Hag. 351
PARABOYSIDIA Pils. 201
parva Stab. 303, 304
partioti Moq. 276
parvidens St. 80
pauperrima B. & D. 225
paviei B. & D. 203
pazi Hid. 102
pediculus Sh. 145, 158
pellucida auct. 71
pellucida Pfr. 75
peninsularis Pils. 24
pentodon Say 28
petrophila Fag. 291
pereximius M. & P..... 247
perlonga Bof. 285
perversa St. 40, 357
pfeifferi Bttg. 96, 98
philippii Cantr. 341
phthisica Bof. 285
phymata West. 312
pilsbryana St. 36
pineta Fér. 322
piniana Fag. 312
plagiostoma Bgt. 325
pleimesi Jick. 119
plicidens Bens. 198
polita Risso 326
polita West. 305
polyodon Drap. 270
polyodon Mlldff. 185
polyodon Moq. 261
polyodon Moq. 283
polyplicata Mühlf. 302
polyptyx Pils. 89
porrecta Mlldff. 222
potteburgensis Krs. 240
poulseni West. 340
primula West. 301
procera Gld. 62
profuga West. 337
provida West. 287
PSEUDOSTREPTAXIS Mlldff. 224
puella Pils. 327
pulchella Moq. 279
pulverea B. & D. 225
punica L. & B. 348
PUPA Bolt. 267
Pupa Drap. 262, 267
Puparia Raf. 268
pusillum Mlldff. 186
pyrenæaria Mich. 287
pyrenaica Boub. 278
pyrenaica Germ. 288
pyrenearia auct. 288

Q

quadrasi Mlldff. 185, 360

quadridens Pils. 57
quadridentata St. 57
quadridentata Kl. 115
quadriplicata Brn. 114
quatuordentata Sac. 115
queenslandica Pils. 159

R

recondita T.-C. 153
refuga West. 355
reibischi Dall. 357
retracta West. 290
rhodanica Loc. 298
rhodia Roth 344
rhombostoma Mlldff. ... 223
ridibunda M. & P. ..125, 359
ringens Mich. 278
ringicula Mich. 272
riograndensis St. 69
riparia Pils. 65
robusta B. & D. 201
rochebruni Mab. 190
roebeleni Mlldff. 186
rossiteri Braz. 147, 158
rossiteri Pils. 167
rossmaessleri Schm. 257
rossmässleri Fag. 280
ruidosensis Ckll. 19
RUPESTRELLA Monts. 332, 341
rupestris Phil. 351
rupestris Rossm. 350
rupicola Say 58
rustica Bgt., Loc. 298
rusticula Bgt. 315, 316

S

sabaudina Bgt. 322
saeva West. 284
salwineana Theob. 207
salwiniana Theob. 206
samoensis Mss. 146, 151
sana Pils. 357
SANDAHLIA West. 258
sardoa Cantr. 339
sarratina Moq. 308
saulcyi Bgt. 336, 338
savii Charp. 342
sawii Mouss. 342
saxicola Moq. 292
scalarina Sowb.....354, 355
scalaris Ben. 353
scalarisca Paet. 354
scalatella Mlldff. 223
schübleri Kl. 270
Scopelophila Alb. 254
secale Drap. 306
secale Sowb. 241
secalina Loc. 307
secalina "Marts." 264
seignaciana C. & F. 128
seligo West. 308
semidens West. 290
senegalensis Malz. 121
serrula Bs. 135
servilis Gld. 70
sibuyanicum Mlldff. ... 184
siligo Roth 308
similis Sterki 17
simoni Bttg. 319
SINALBINULA Pils.
11, 103, 116, 118
SOLATOPUPA Pils. 234
Solidula F. de W. 267
solitaria Sm. 88
soluta Pfr. 244
stabilei Marts. 318
stabili Marts. 319
sterkiana Pils. 127, 357
stoaphora Bs., Bp. 245
Stomodonta Merm. ..262, 268
strangei Pfr. 157
striolatus Mlldff. 215
strophostoma Mlldff. ... 197
subantiqua Lom. 270
subcylindrica Loc. 300
subfusiformis Kl. 270
sublaevigata Bgt. 310
subringens Fag. 279
subulata Biv. 340
subvariabilis Sandb. 269
suevica Sdb. 115

SYSTENOSTOMA B. & D... 224

T

Tanystoma Bens. 175
tapeina Bgt. 116
tappaniana Ad. 33
tappiana Ward 33
tatei Pils. 165
taurica Kessl. 345
tenuidens C. B. Ad. 229
tetrodon West. 338
theeli West. 118
thibetica Bs. 138
TOMIGERELLA Pfr. 241
tomlini Bp. 252
TONKINIA Mab. 175, 176, 359
Torquilla Studer 262
transiens Boub. 286
transitans Mlldff. 214
transitus Boub. 286
triptycha Mlldff. 223
triticea Ziegl. 298
triticum Ziegl. 303, 304
tuba P. & F. 2
tubiferum Bens. 178
turbiana Caz. 338
turgida Reuss. 115
turgida Parr. 300
tuxensis Fag. 277

U

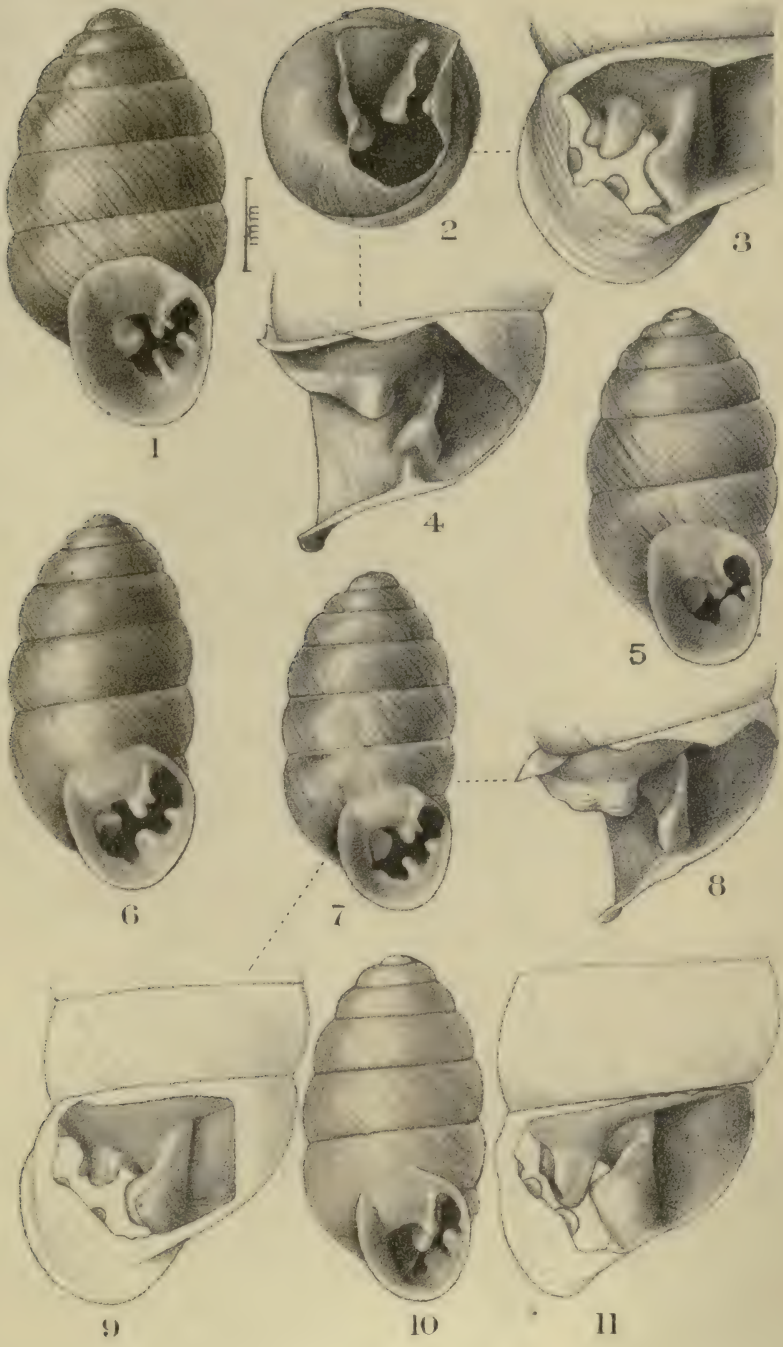
ulmensis Schl. 269
undorfensis Pils. 117
unicarinata P. & M. 356
uvulifera Gupp. 87

V

valcourtiana Bgt. ...315, 317
variabilis Drap. 321
variolosa Gld. 230
ventricosa Loc. 272, 300
vergniesiana Ch. 286
VERTIGO 116
VERTIGOPSIS Ckll. 11, 27
vouastensis Rasp. 269

W

wallabyensis Sm. 171
wolfii Mill. 94, 357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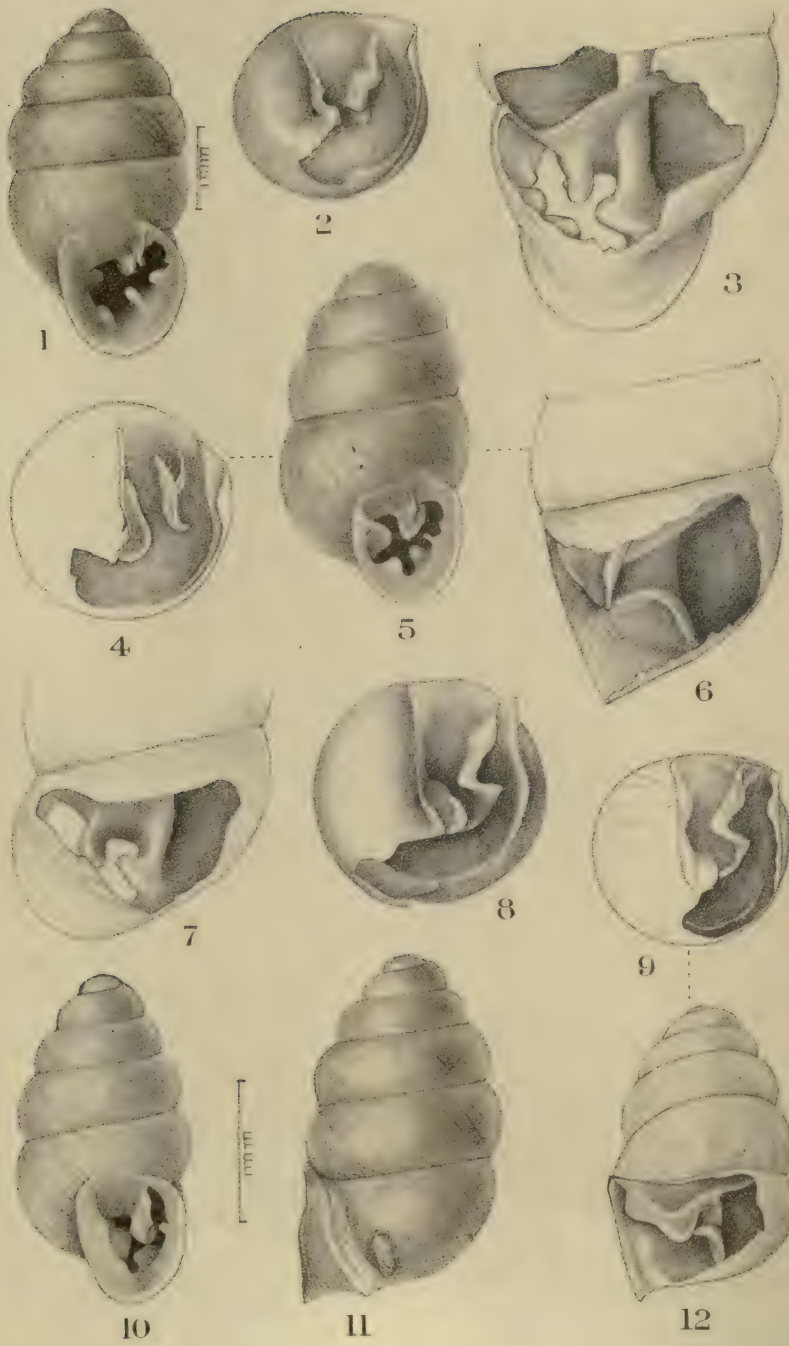
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8
9
10
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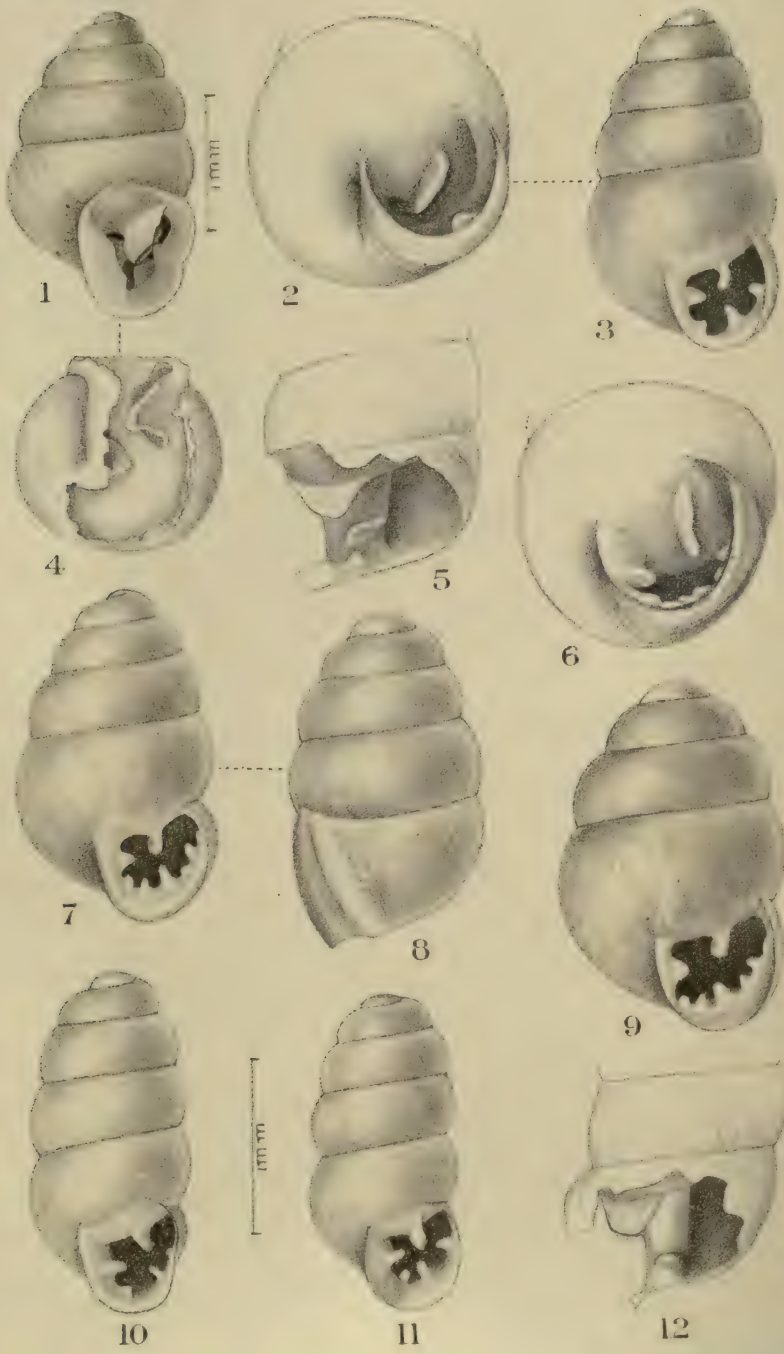
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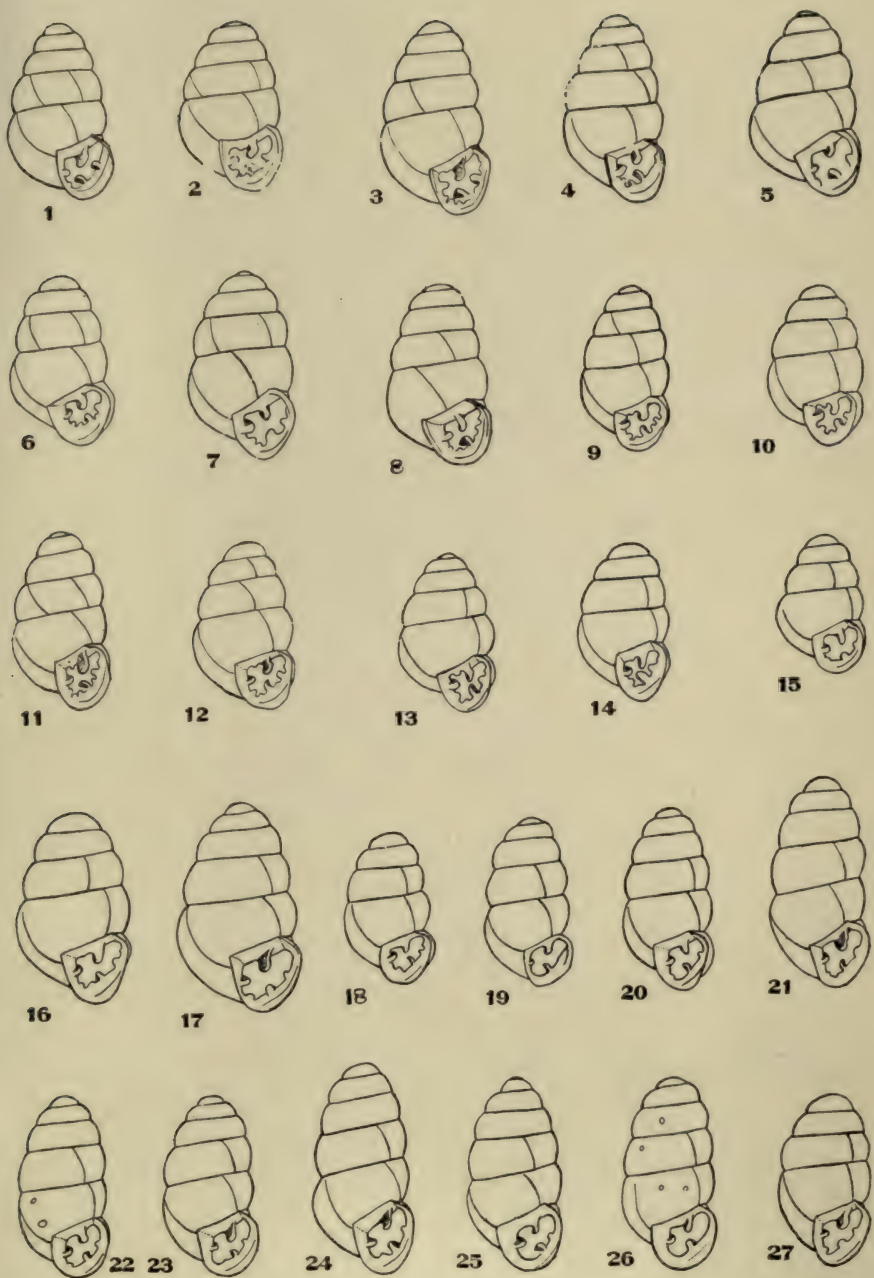
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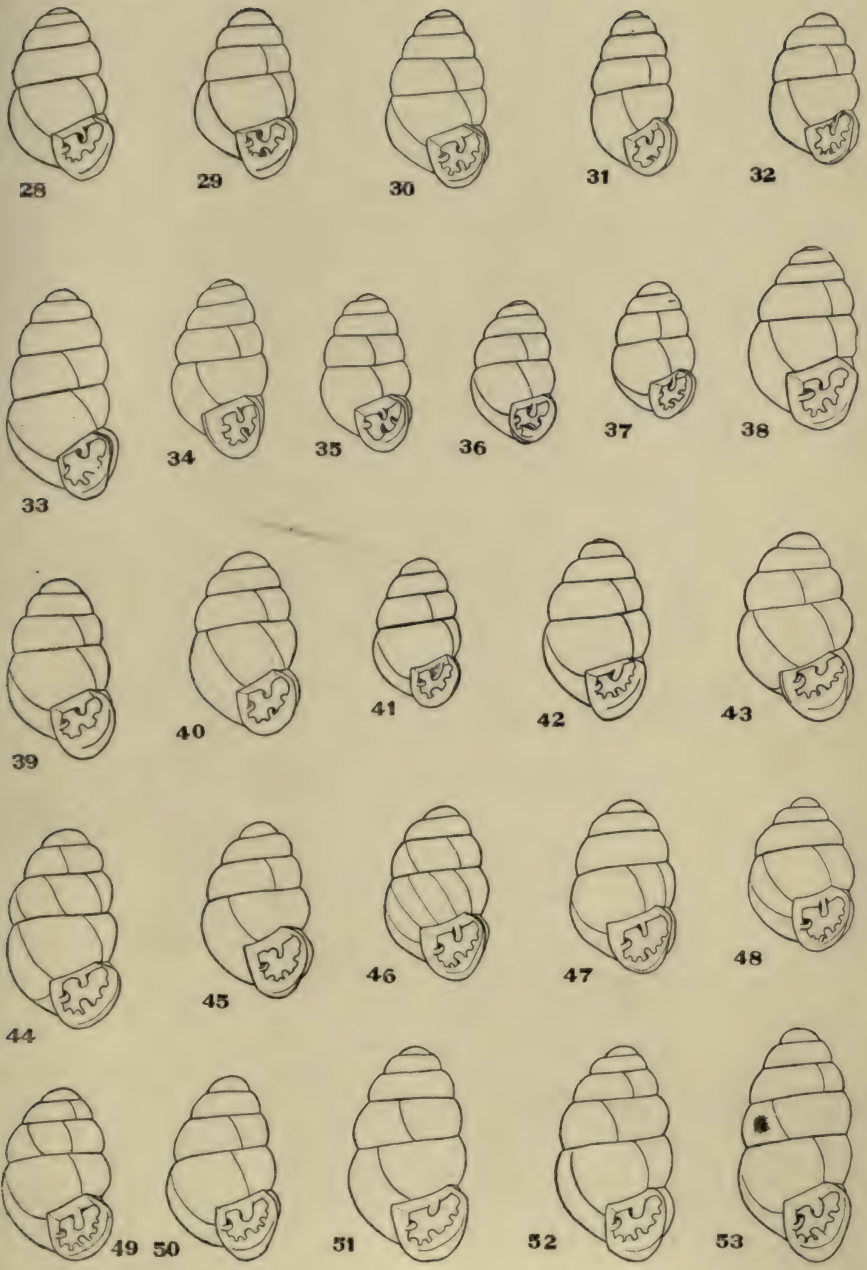
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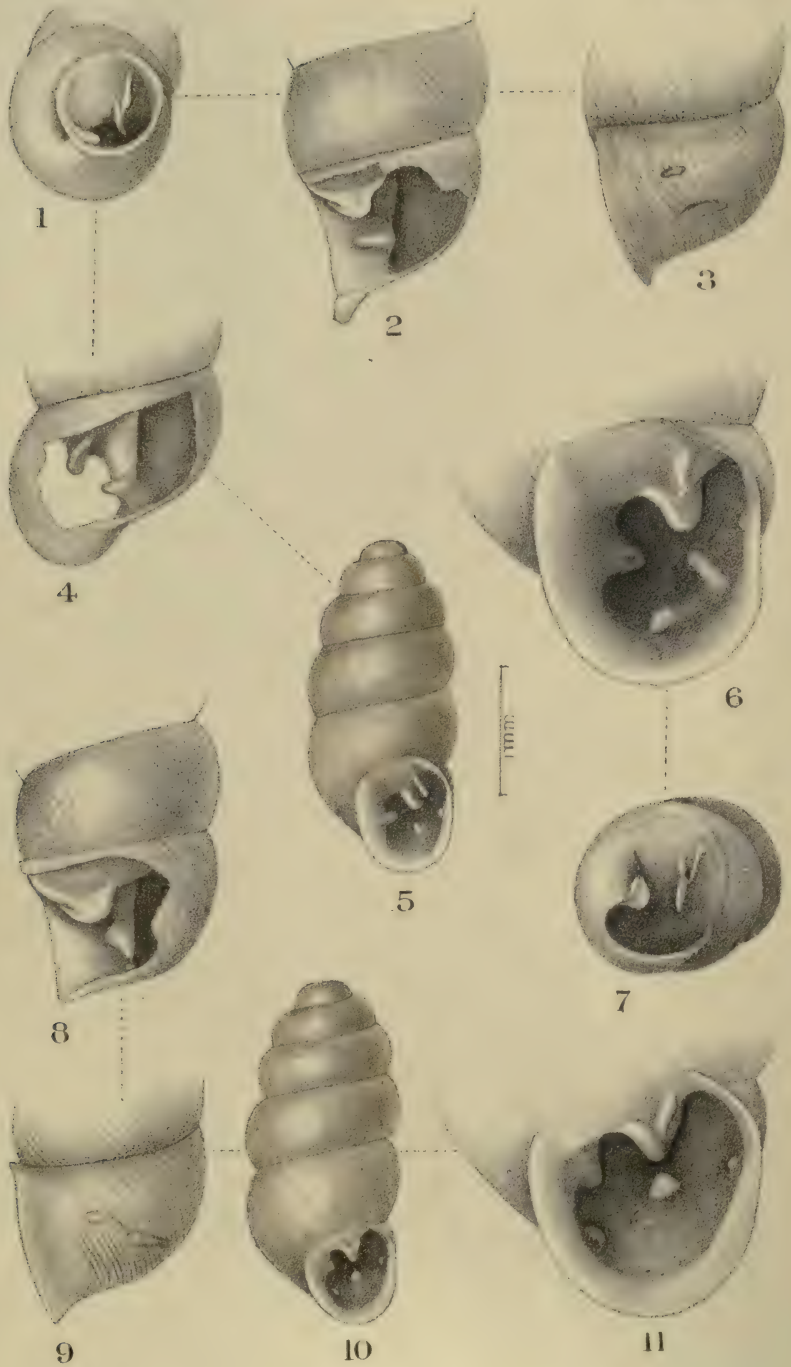
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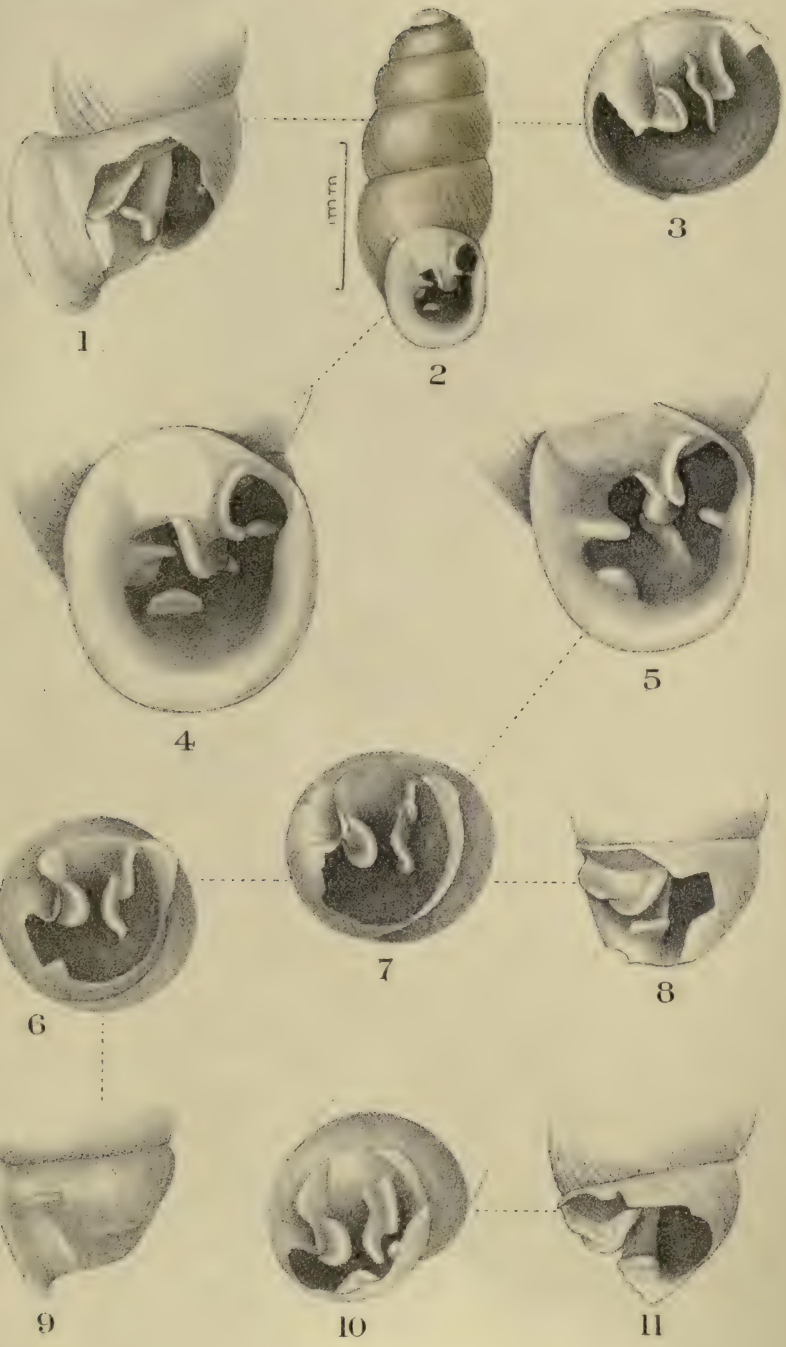
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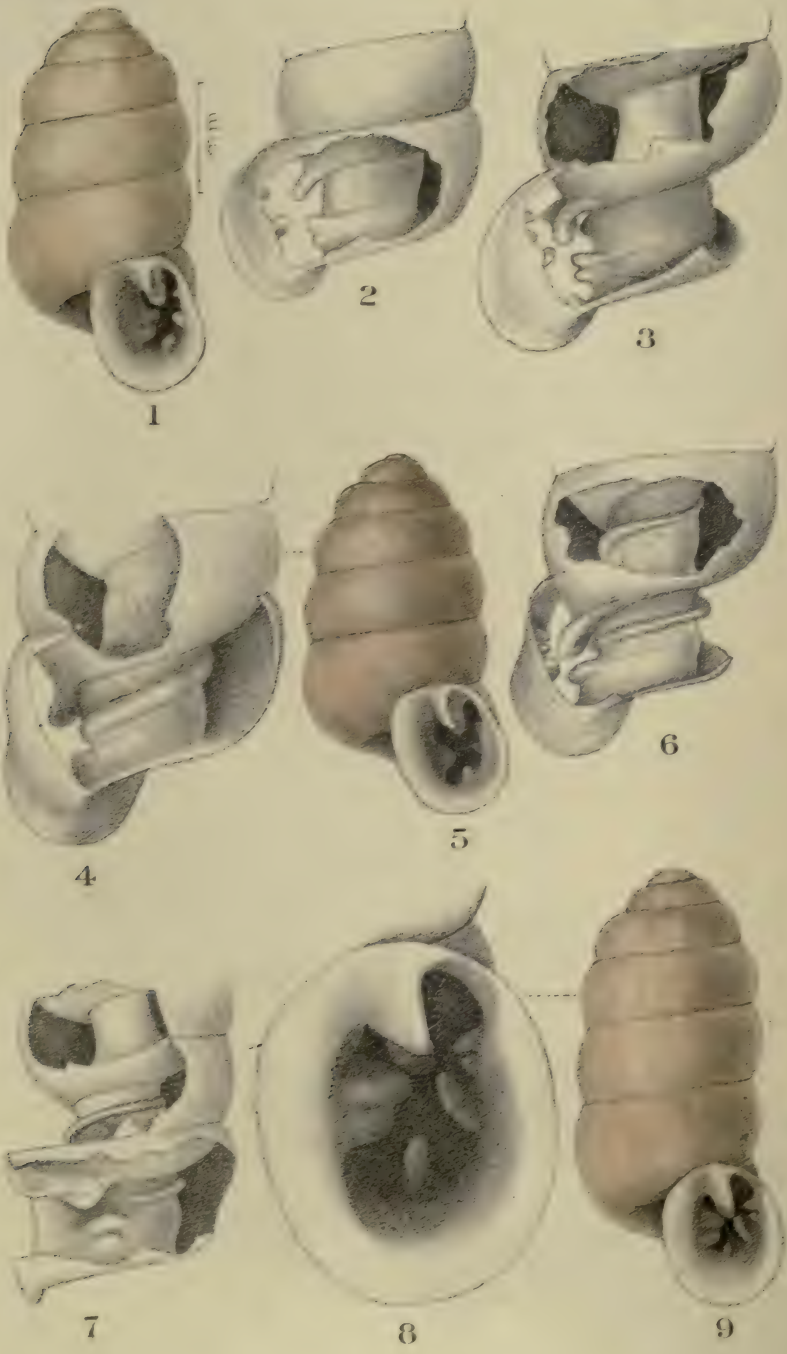
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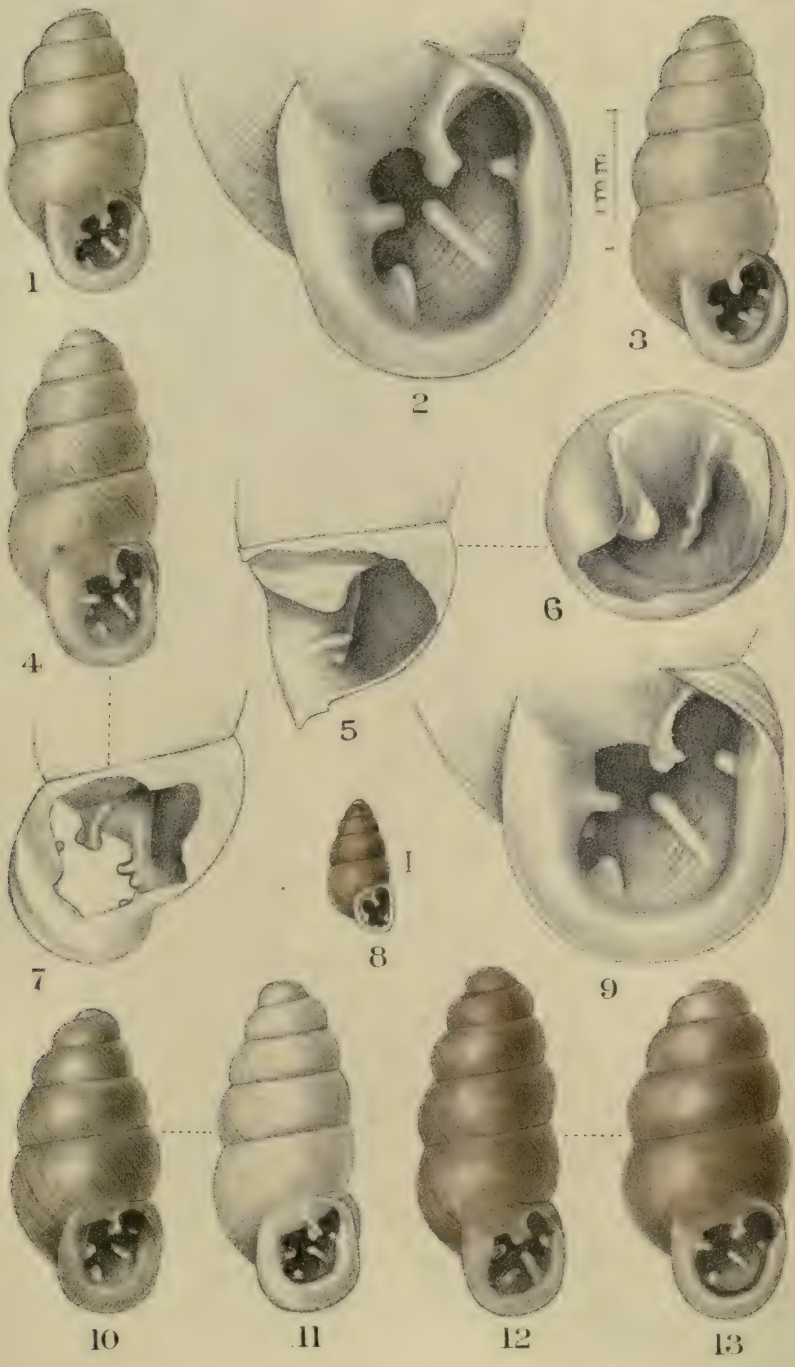
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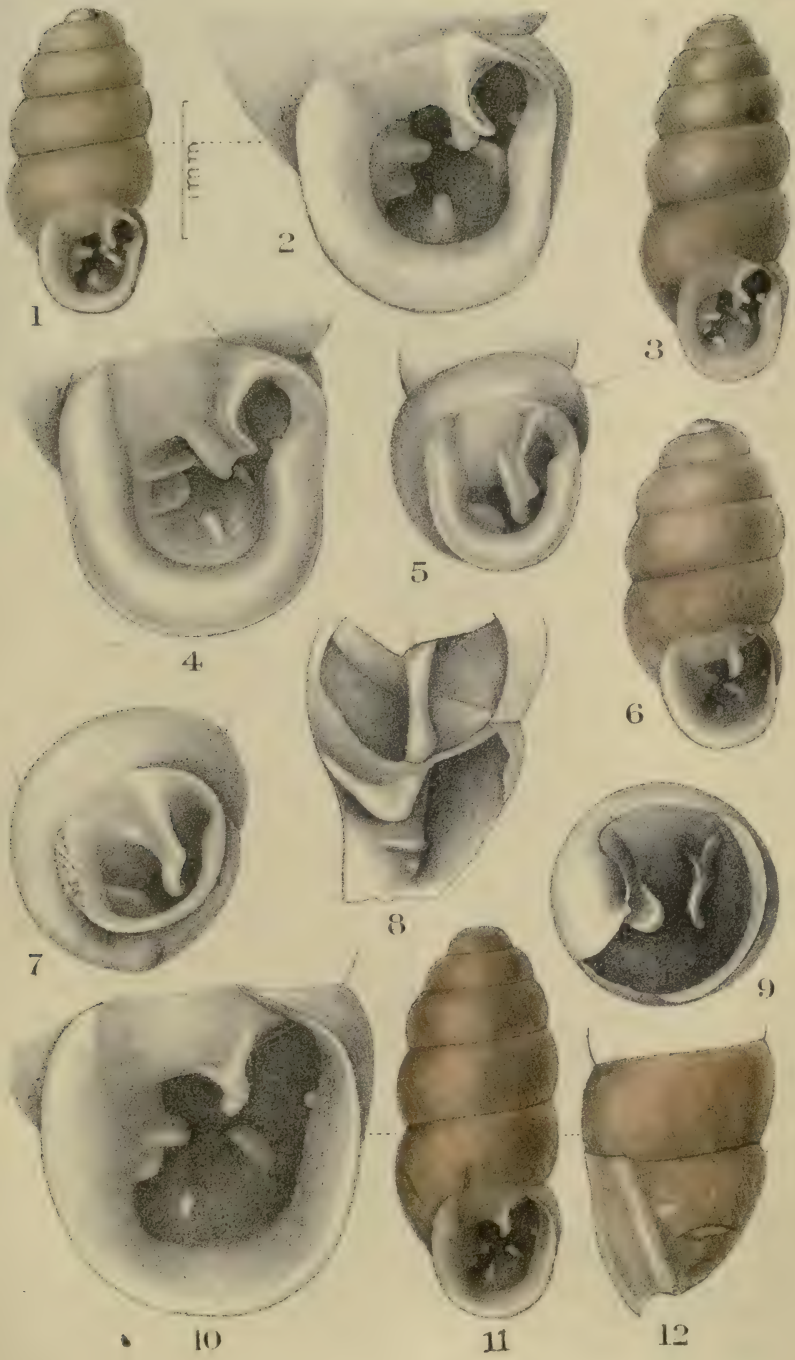
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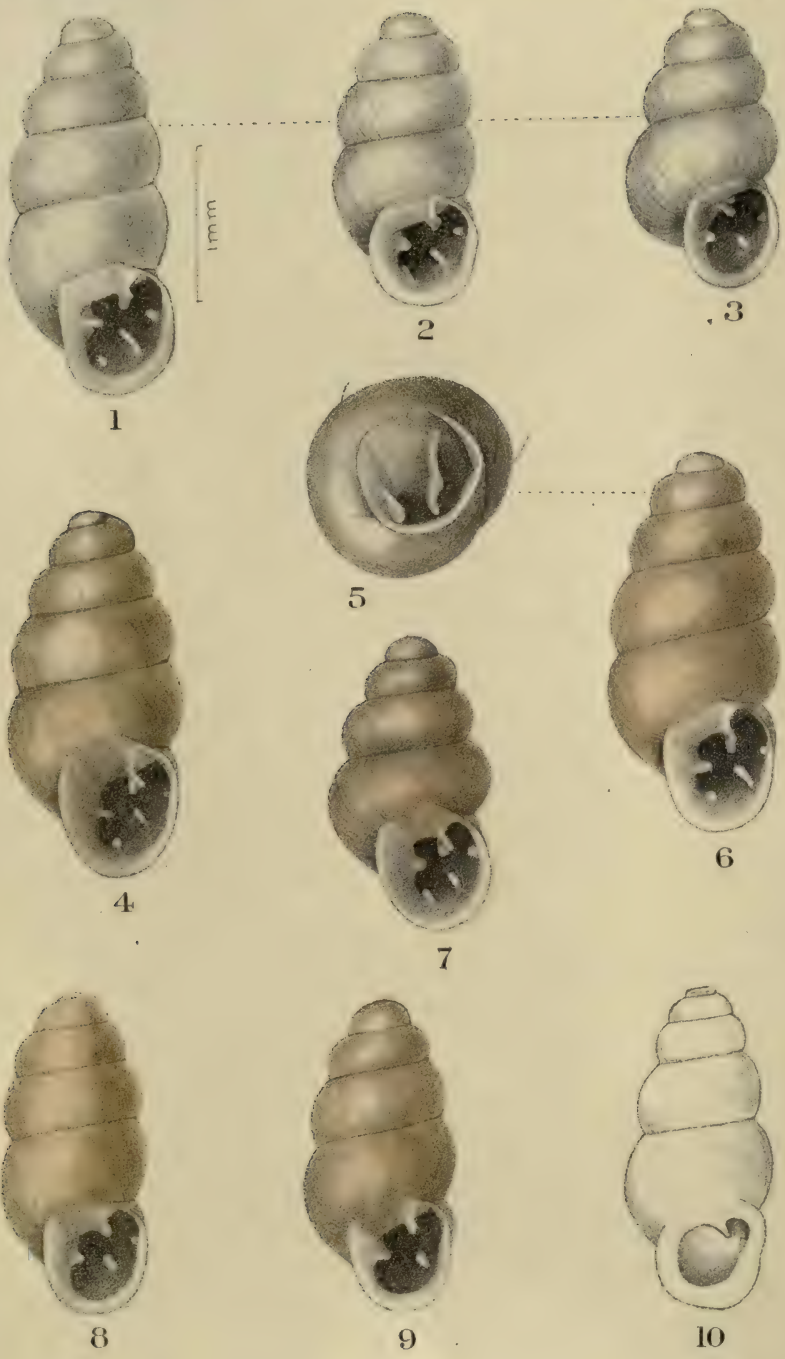
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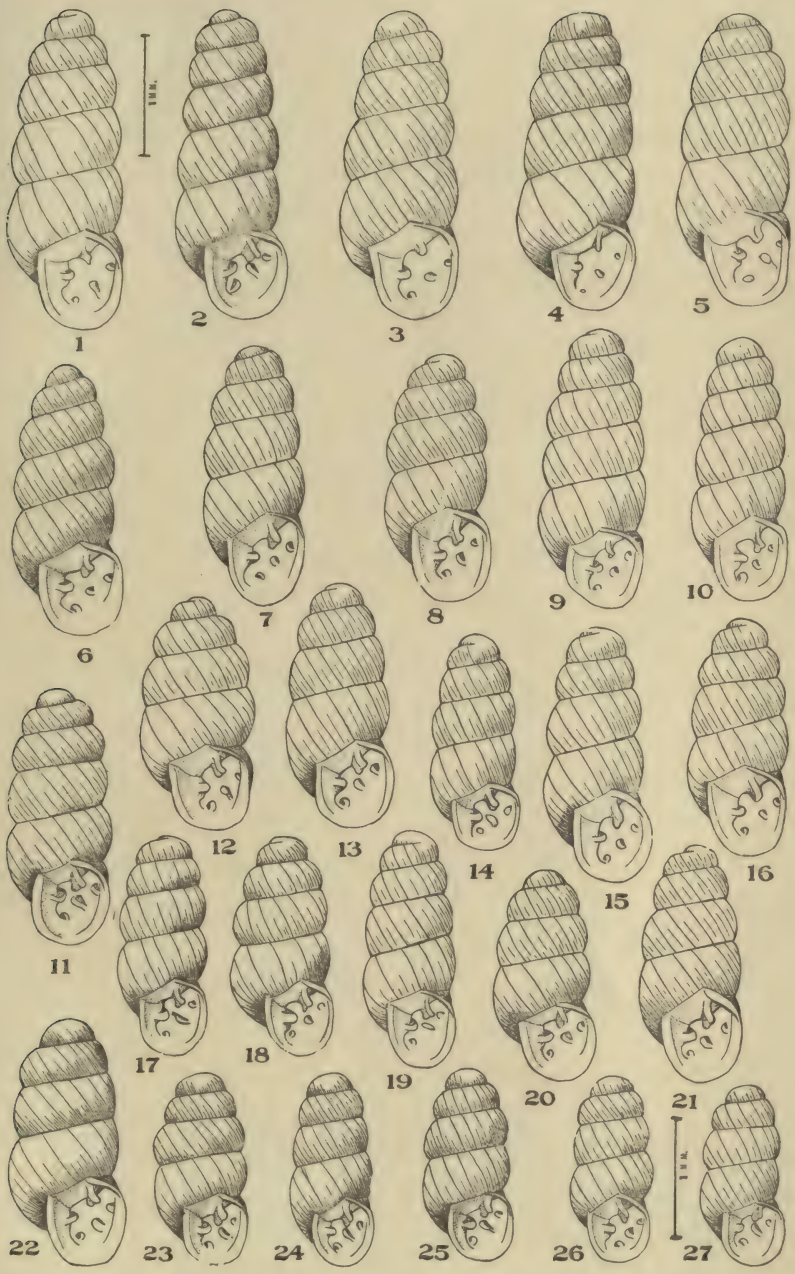
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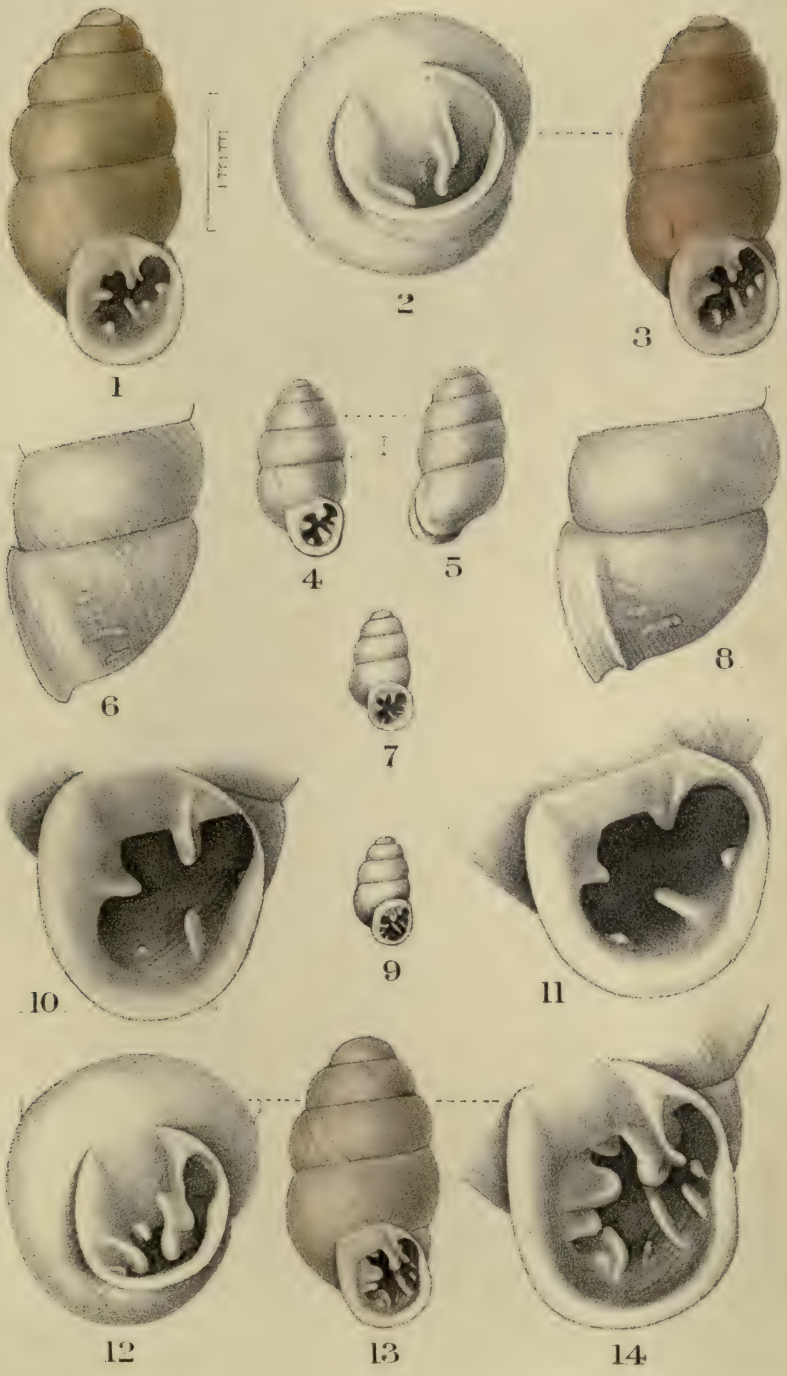
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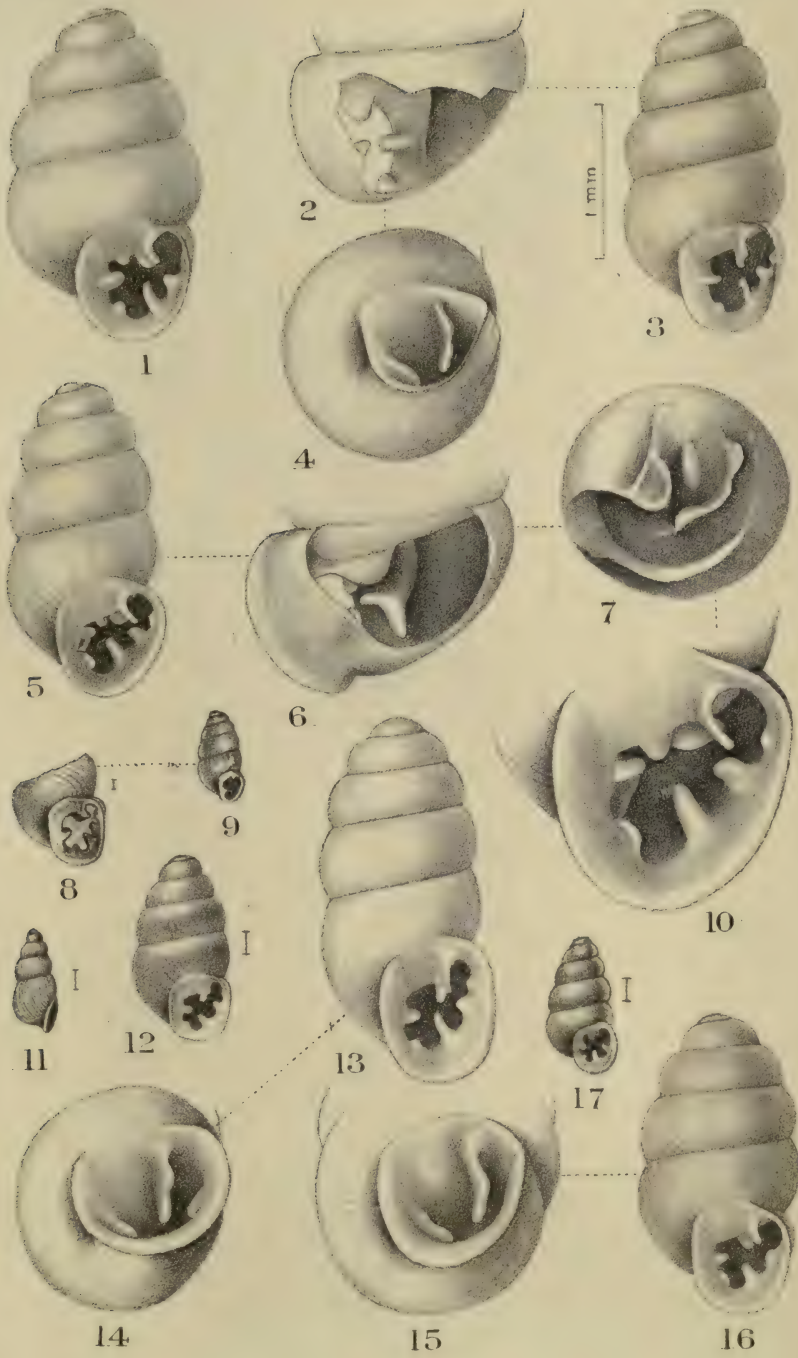
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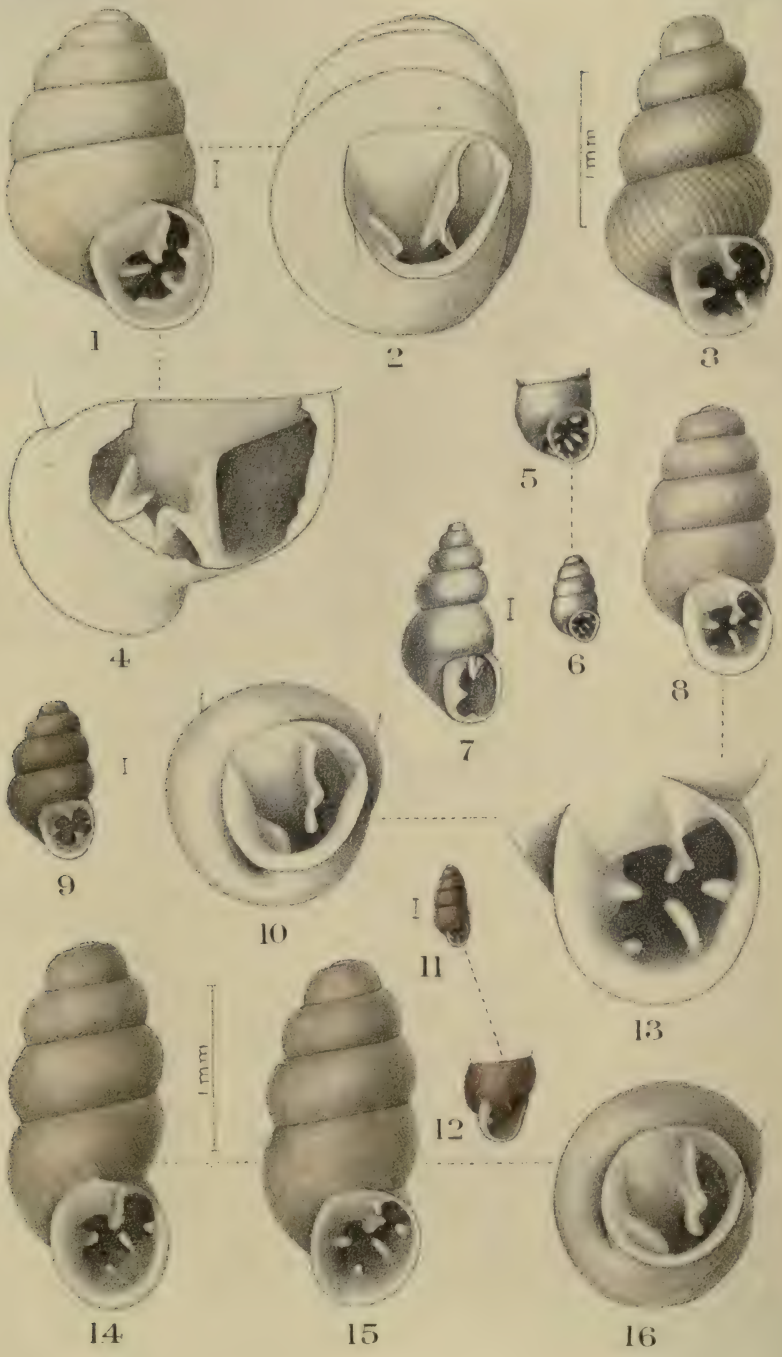
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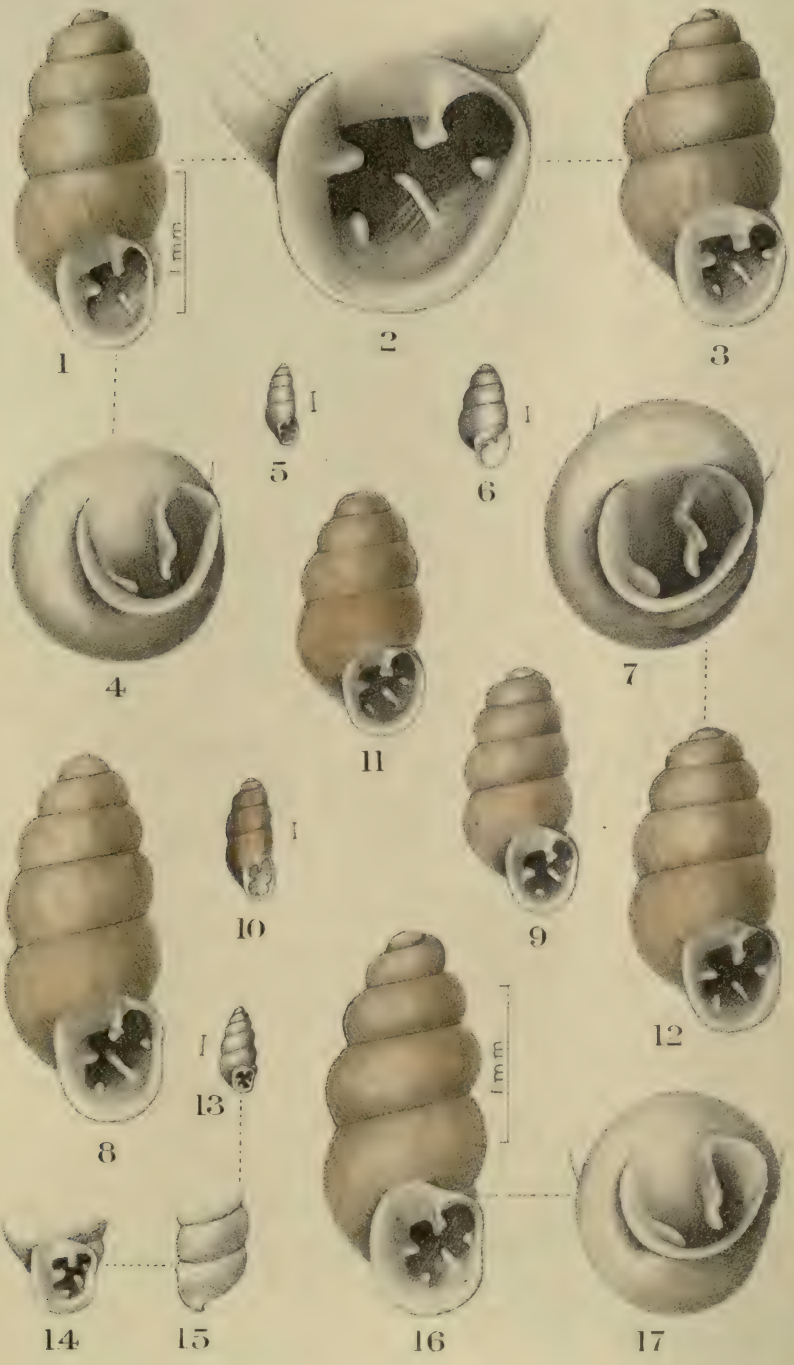
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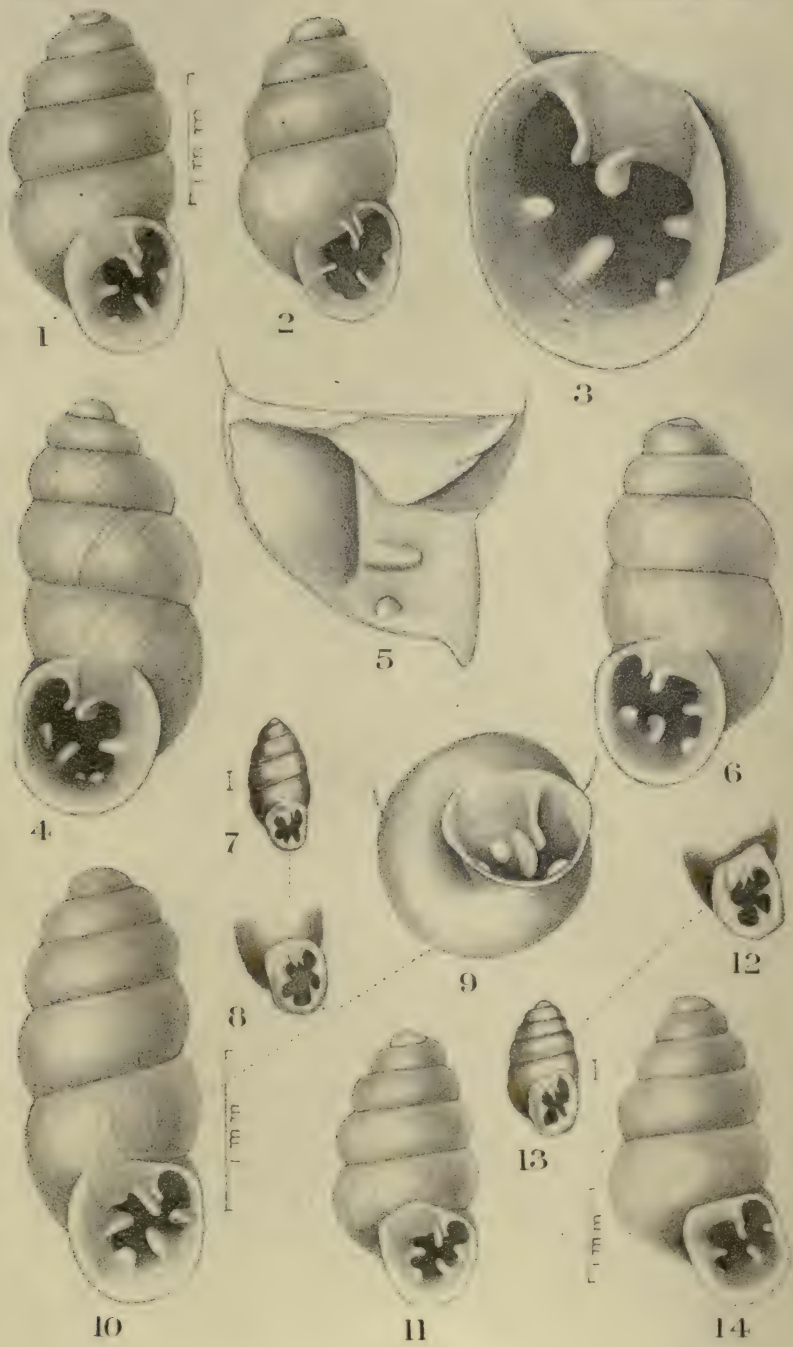
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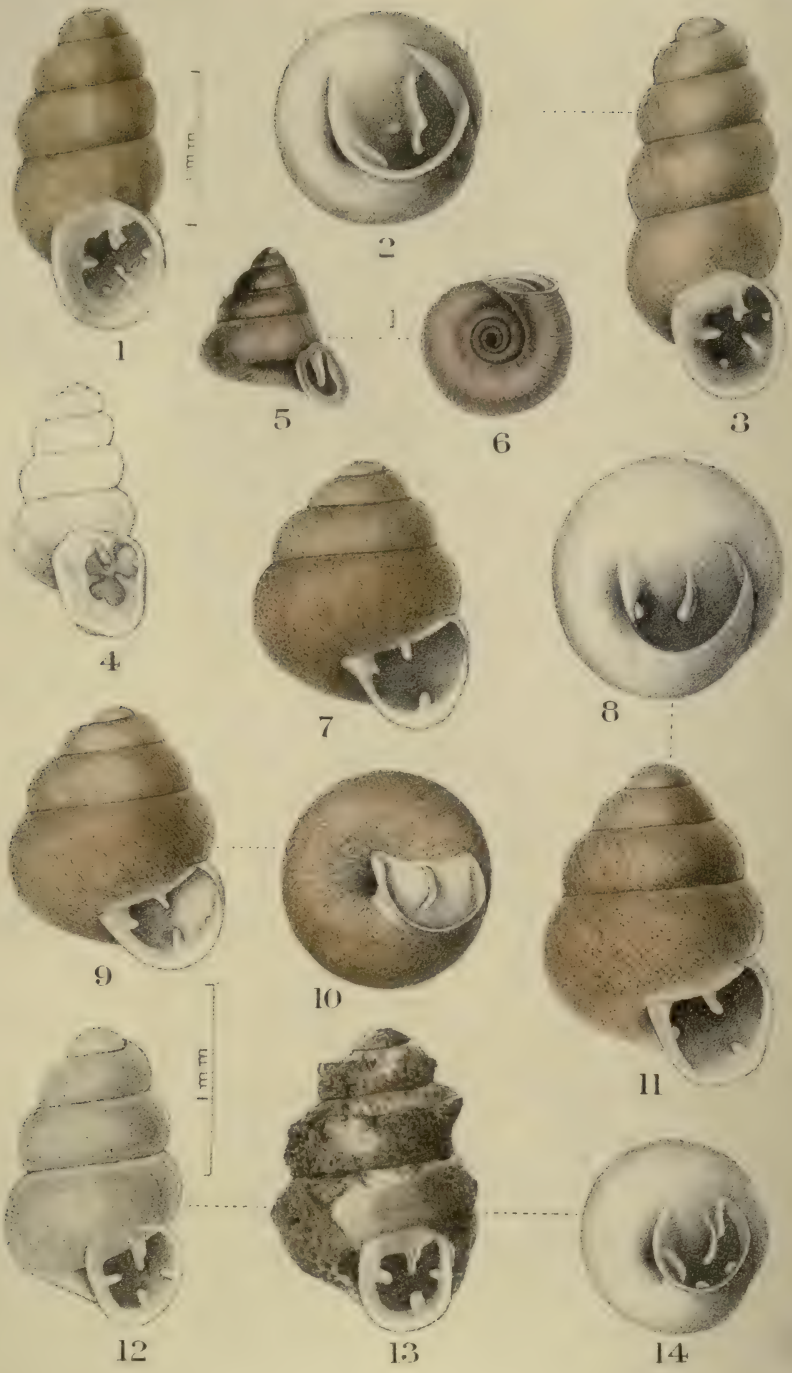
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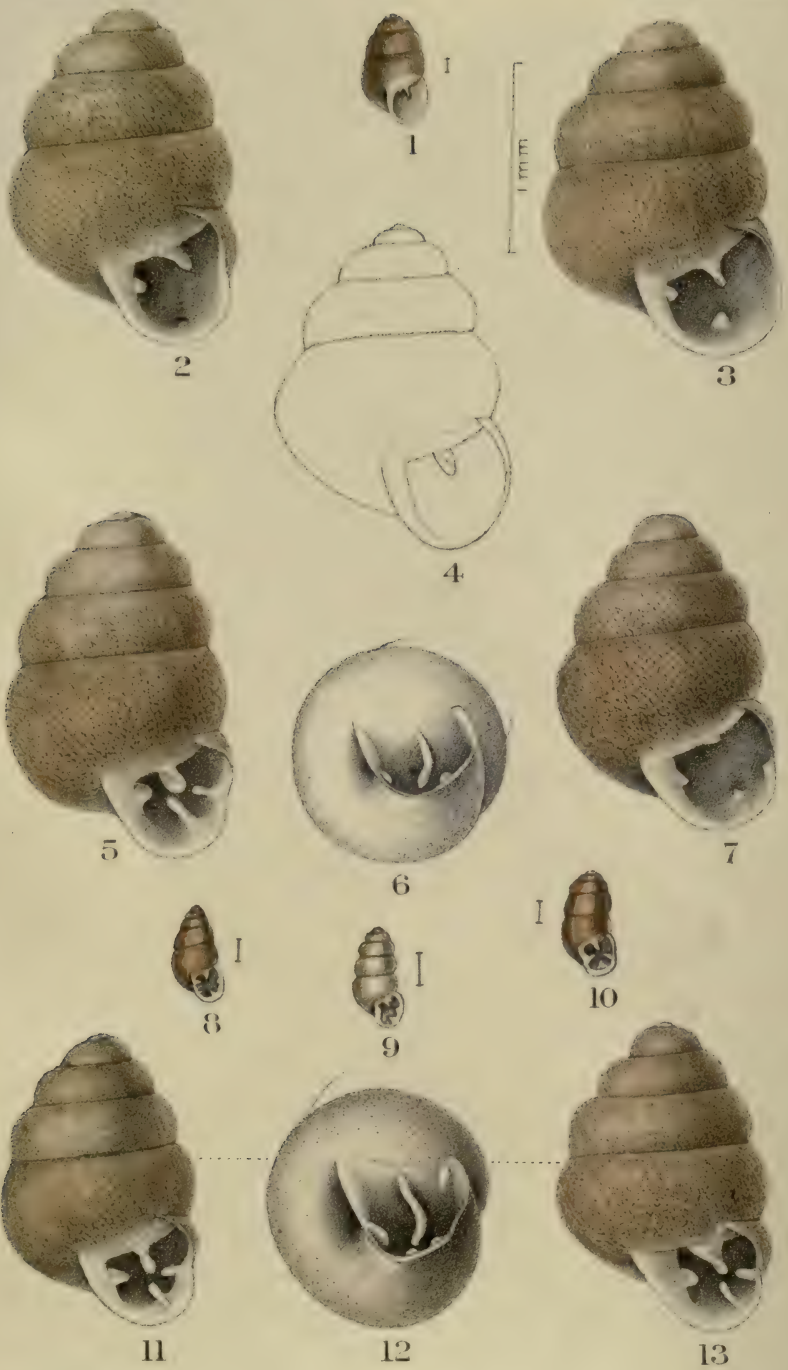
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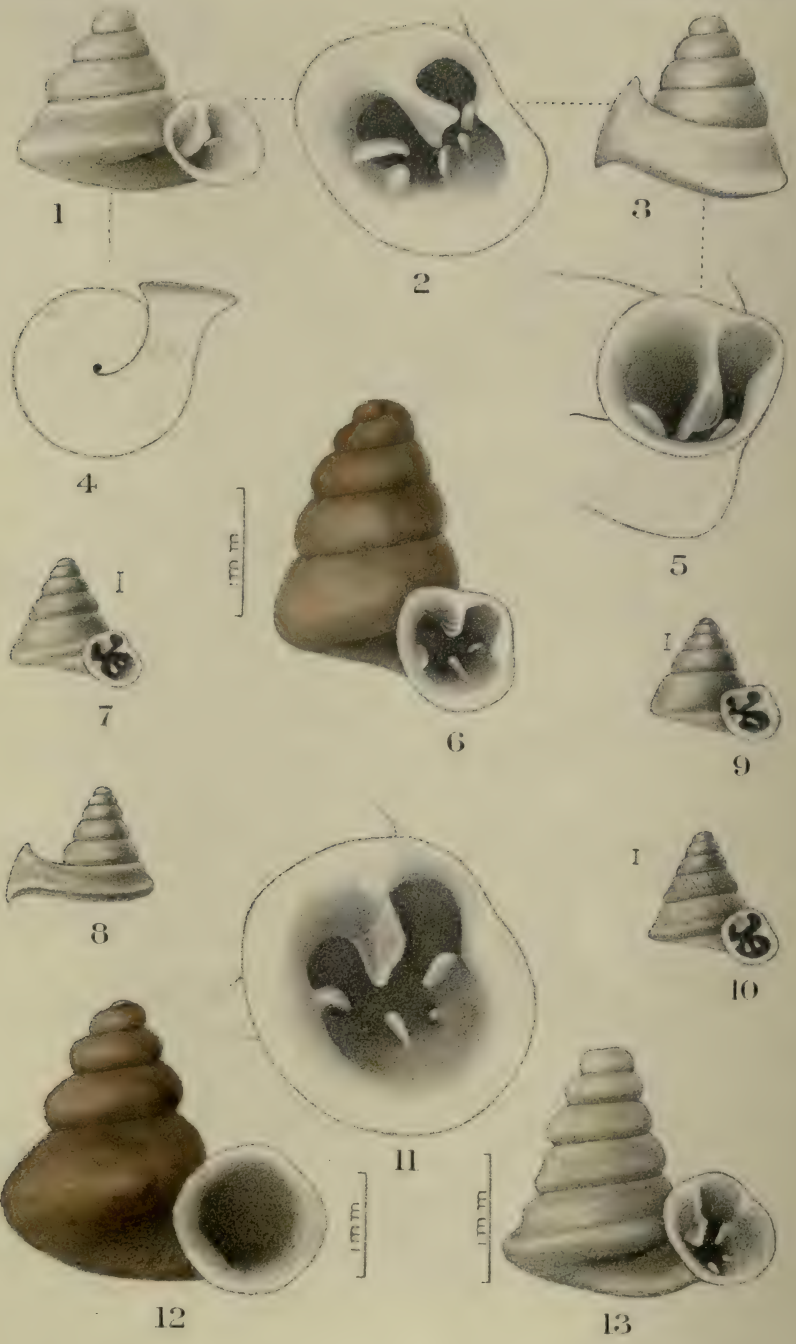
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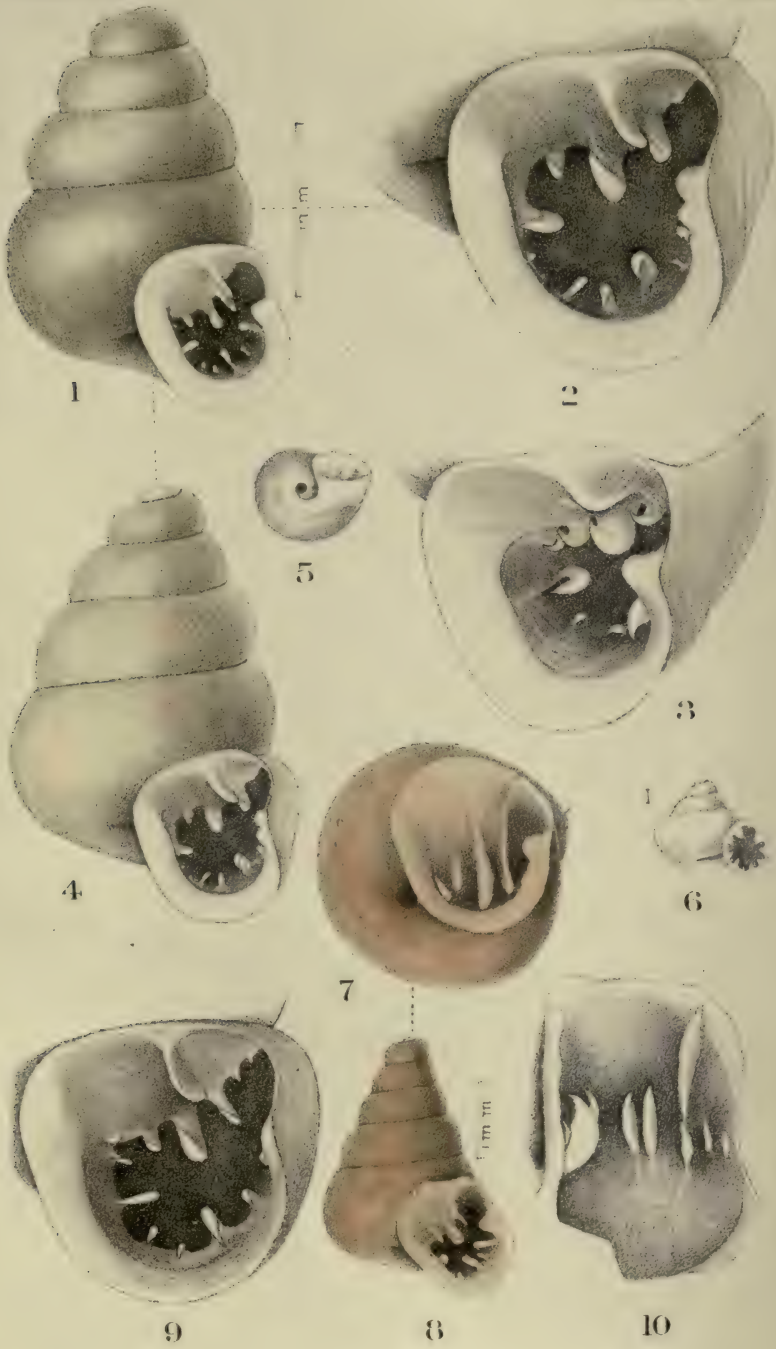
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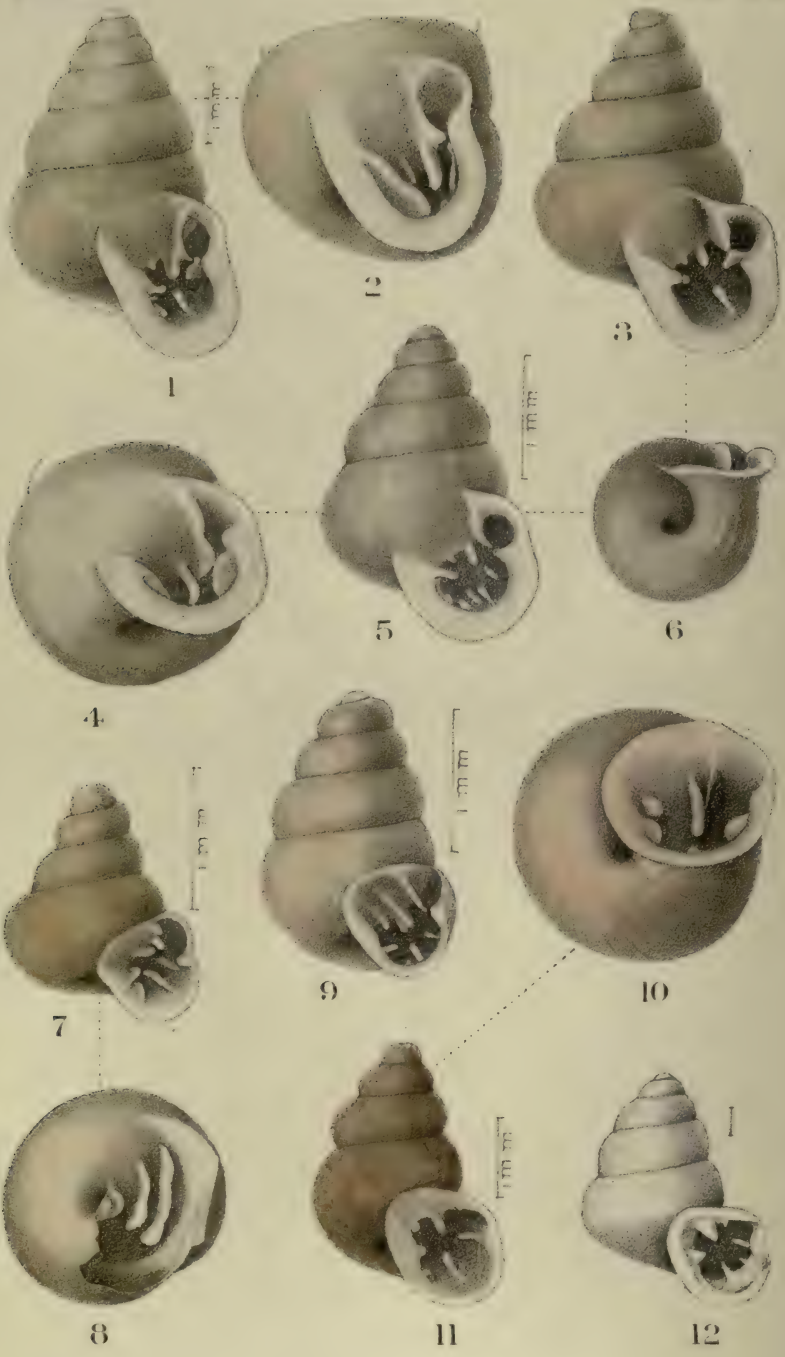
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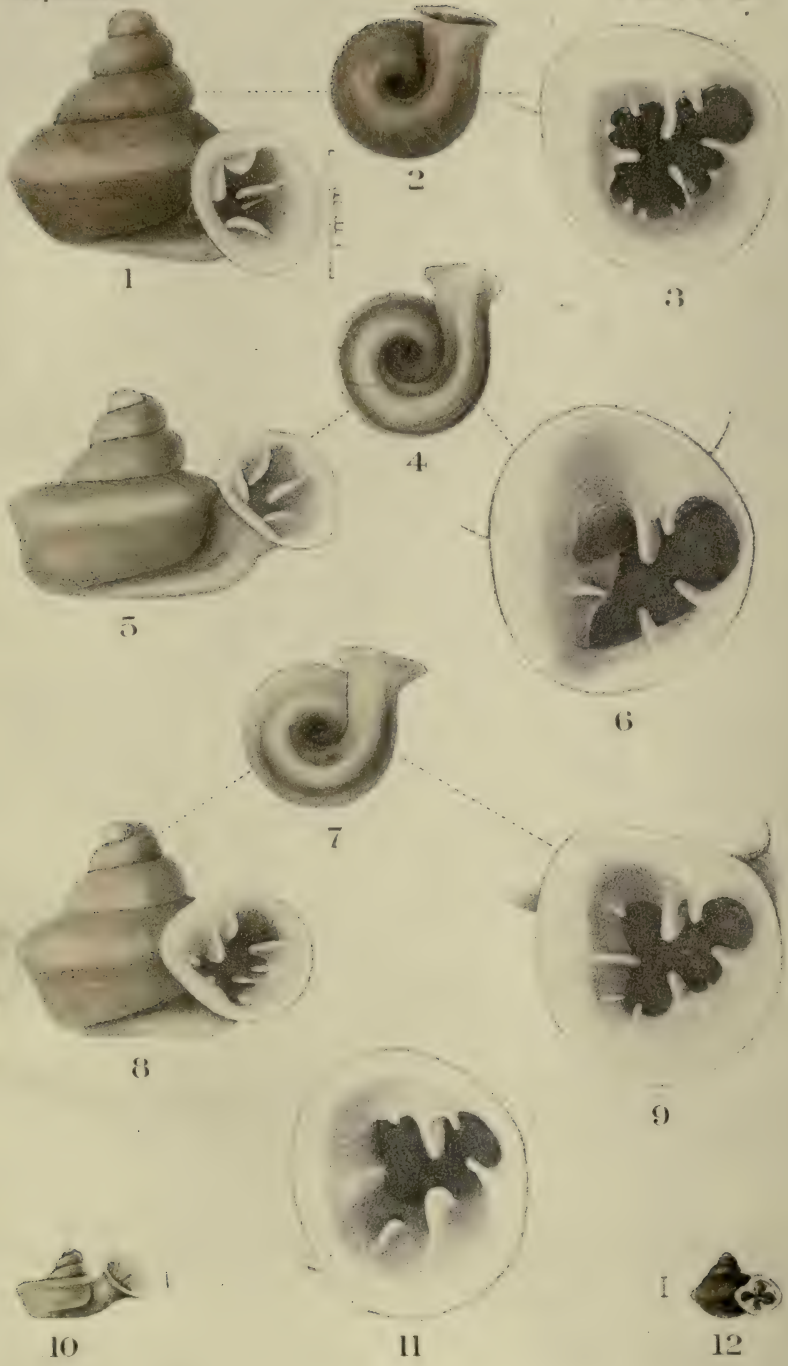
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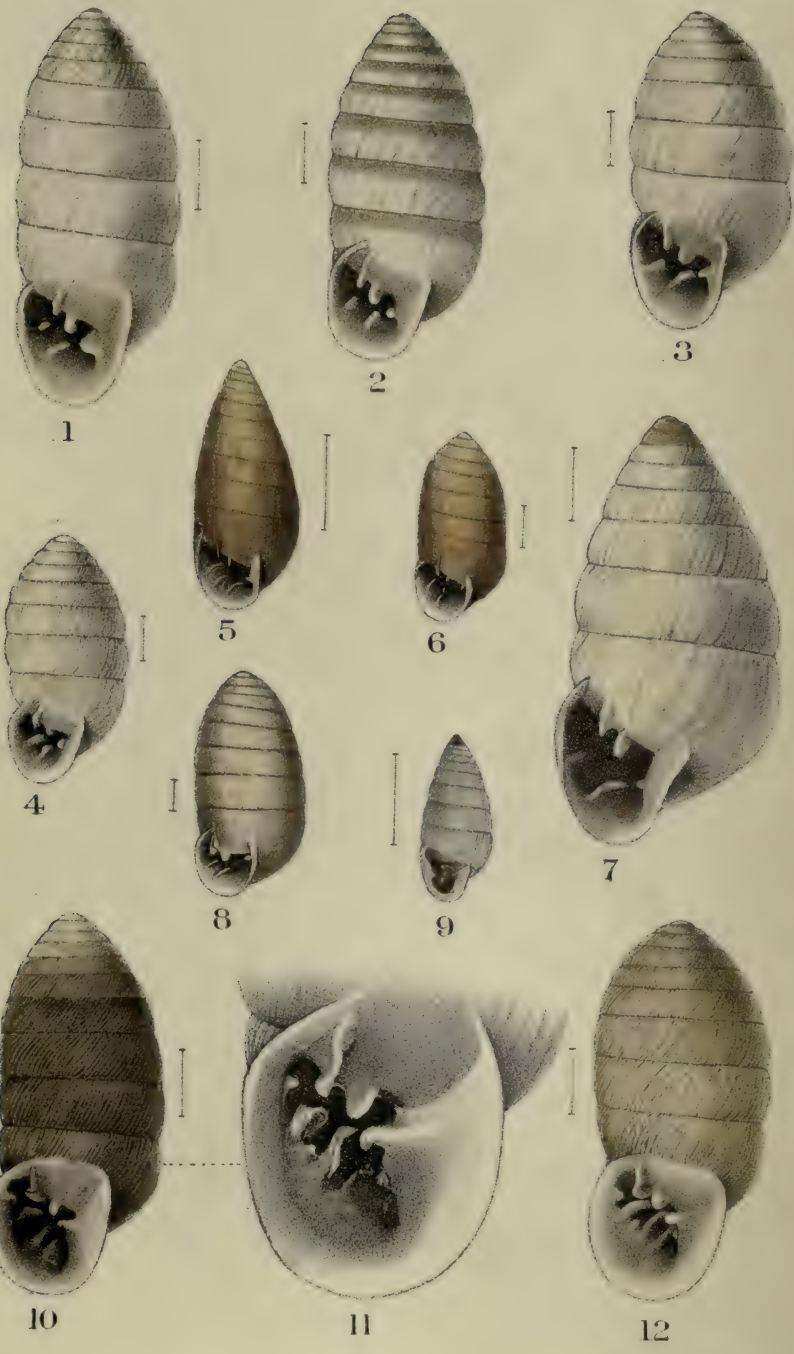
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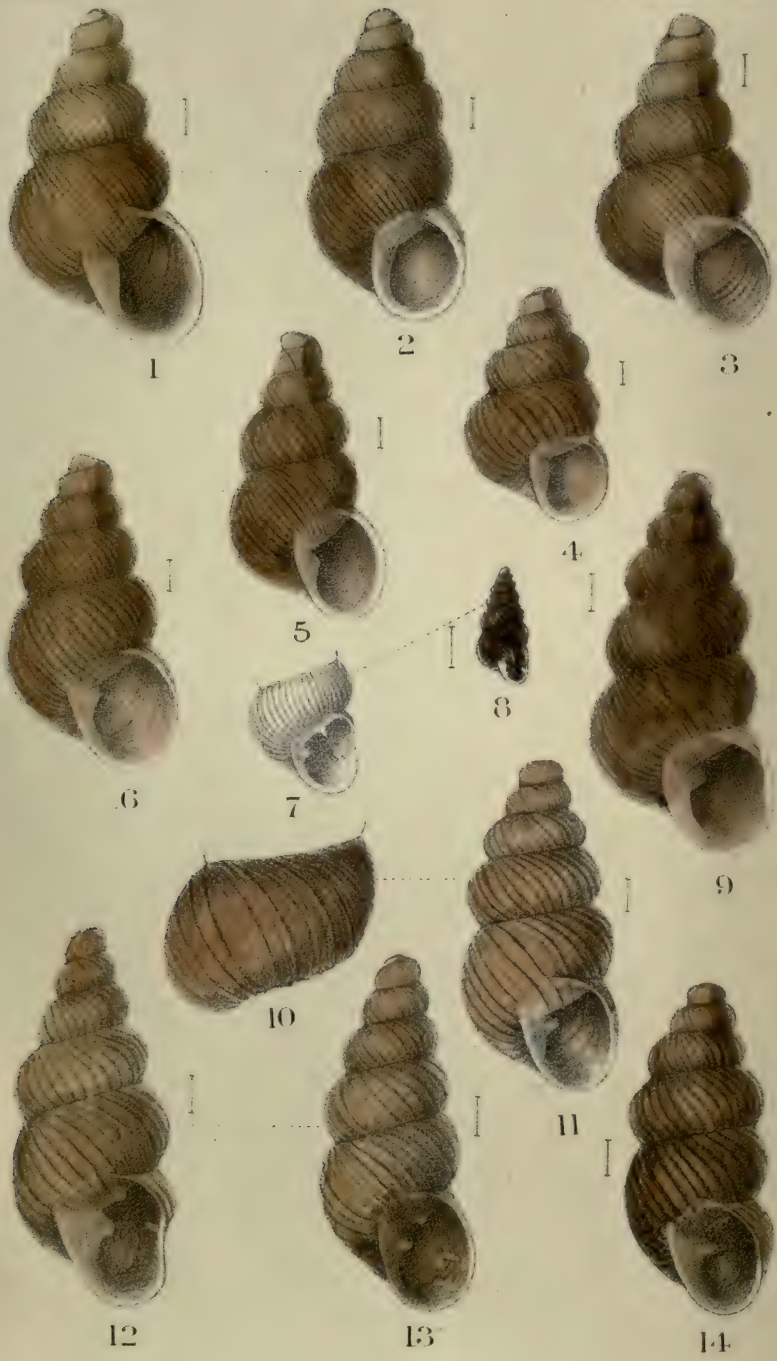
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